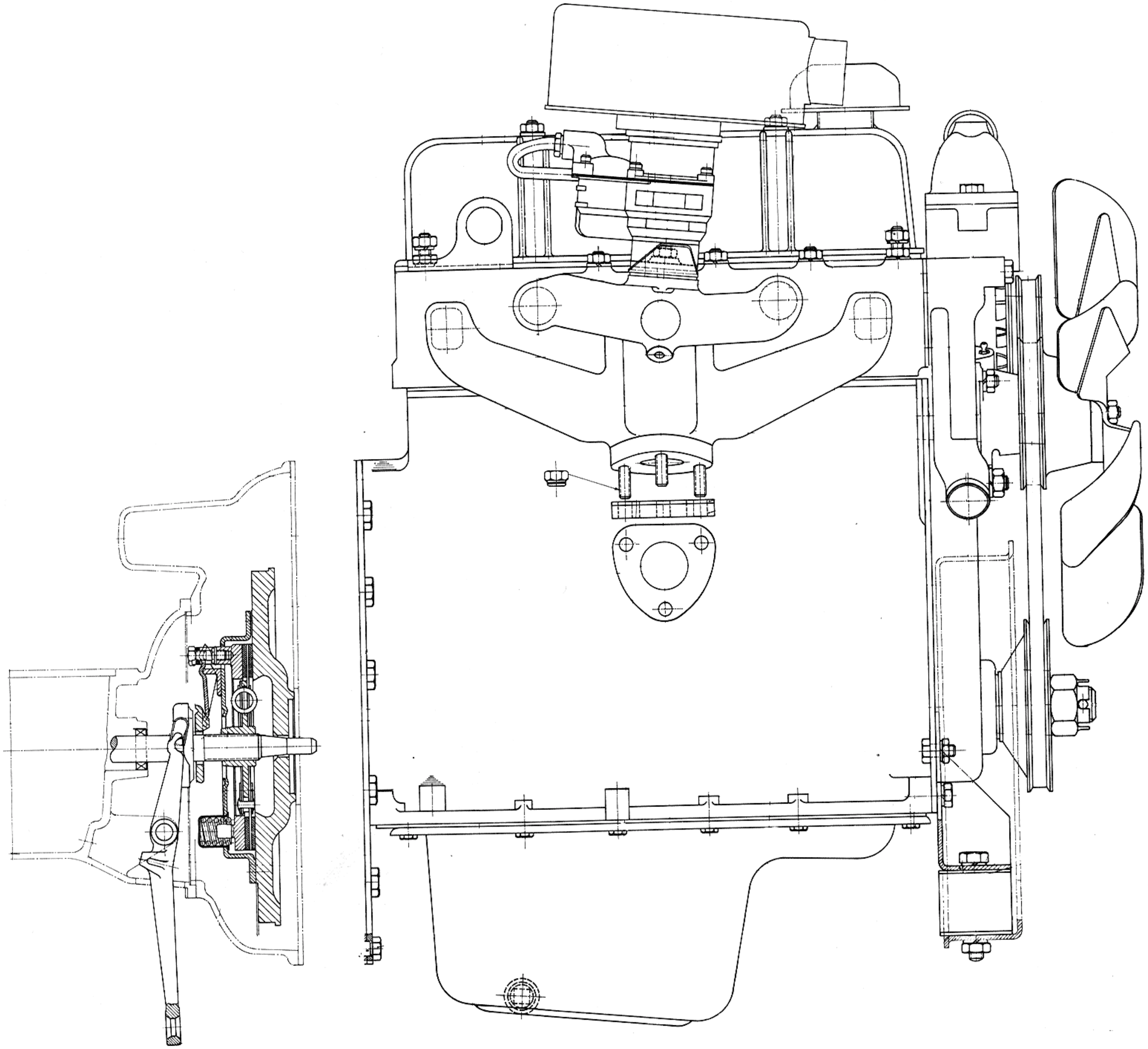
MAINTENANCE MANUAL

Model 770

AMPHICAR



INTRODUCTION

This manual has been compiled to provide guidance to those responsible for the maintenance' and overhaul of the Amphicar.

This manual is divided into the 12 main groups, each of them being consecutively numbered so that supplementary sheets may be inserted, from time to time.

All instructions for the maintenance and overhaul are based on methods which have been proved with the aid of our Amphicar special tools.

Modifications and changes which may at any time be introduced, will be issued to all authorized dealers.

AMPHICAR CORPORATION OF AMERICA

New York 23 N.Y. 1840 Broadway

Phone: LT 1-6969

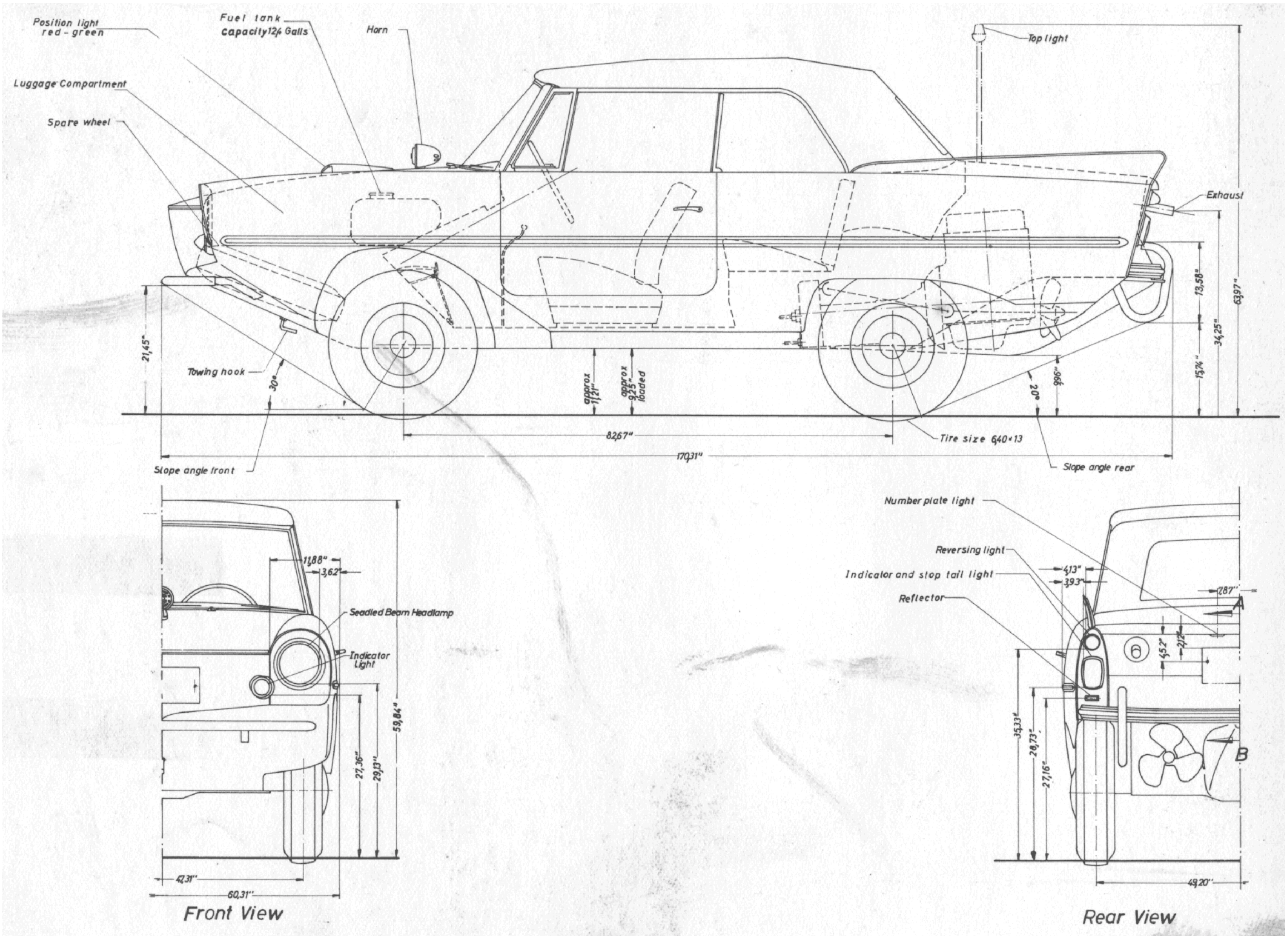
Postcard

AMPHICAR CORPORATION OF AMERICA
1840 Broadway
New York 23 N.Y.

Attention:

Please return the attached postcard to us immediately affixed with your exact address (possibly firm stamp). This only guarantees that you will get all supplements and changes of this catalogue automatically at no extra cost.

INDEX OF GROUPS



Position light red - green
Fuel tank Capacity 12¼ Galls
Horn
Top light
Luggage Compartment
Spare wheel
Exhaust
Towing hook
21,45"
30°
approx 11,21"
approx 9,25" loaded
13,58"
34,25"
63,97"
15,74"
9,96"
20°
82,67"
Tire size 6,40×13
170,31"
Slope angle front
Slope angle rear
11,88"
3,62"
Seadled Beam Headlamp
Indicator Light
27,36"
29,13"
59,84"
47,31"
60,31"
Front View
Number plate light
Reversing light
4,13"
3,93"
Indicator and stop tail light
2,87"
Reflector
A
4,52"
2,12"
35,33"
28,73"
27,16"
B
49,20"
Rear View

GENERAL - DATA:

ENGINE

Engine type	Standard Triumph 1147 c.c.
Number of cylinders	4
Bore	2.718" (69,3 mm)
Stroke	2.992" (76 mm)
Capacity (swept volume)	70 c u. ins. 1147 cc
Compression ratios	8 : 1
Compression pressure	Readings obtained on all 4 cylinders must be within 5 lb. sq. in. (4 kg sq. cm) of each other.

PERFORMANCE (8 : 1 COMPRESSION RATIO)

max.h.p. (S.A.E.)	43 at 4,500 r.p.m.
max. torque	775 lb. in. at 2.250 r.p.m.
max. B.M.E.P.	139 lb.sq.in. (9.77 sq.cm)

GEARBOX

Type	4 forwards		1 reverse synchromesh		
Ratio	Top	3rd	2nd	1st	Reverse
	1.05	1.75	2.91	4.5	4.13
Differential	4.714				

WATER TRANSMISSION BOX

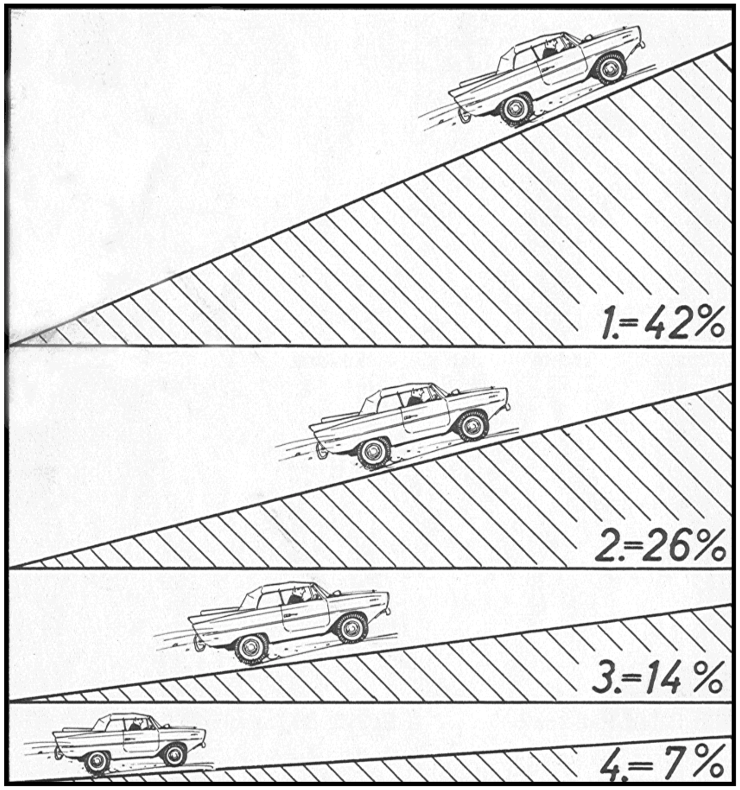
Type	1 forward	1 reverse
Ratio	1 : 3	

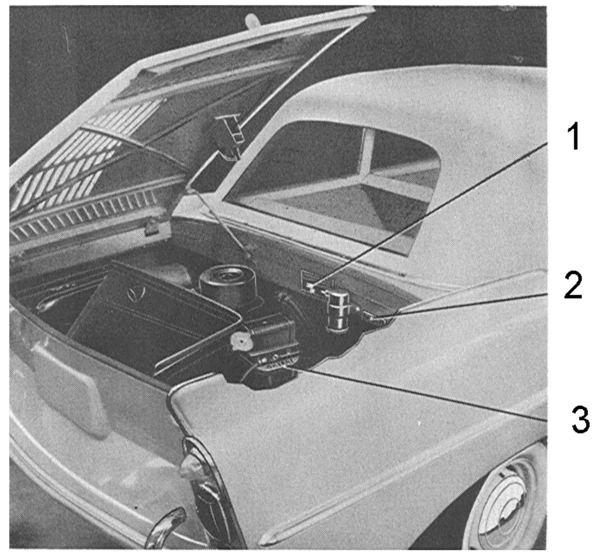
DIMENSIONS

Overall length	170,31" (4326 mm)
Overall width	60,31" (1532 mm)
Overall height	59,84" (1520 mm)
Overall height with inserted top light	63,97" (1625 mm)
Wheelbase	82,67" (2100 mm)
Track front	47,31" (1202 mm)
Track rear	49,20" (1250 mm)
Ground clearance	9,96" (253 mm)
Turning circle	36,42 ft (11.10 m)

WEIGHTS

Weight with filled fuel tank	2.292,80 lbs (1040 kg)
Payload	4 Persons
Permissible total weight	2.954,18 lbs (1340 kg)
Permissible front axle load	1.128,77 lbs (512 kg)
Permissible rear axle load	1.825,41 lbs (828 kg)


1.=42%
2.=26%
3.=14%
4.=7%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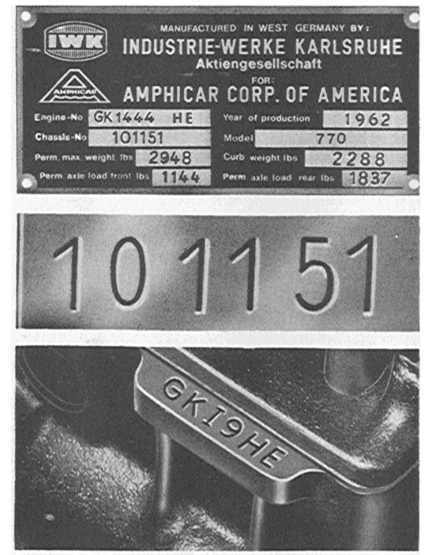

MANUFACTURED IN WEST GERMANY BY:
IWK
INDUSTRIE-WERKE KARLSRUHE
Aktiengesellschaft
FOR:
AMPHICAR CORP. OF AMERICA
Engine-No GK1444 HE
Year of production 1962
Chassis-No 101151
Model 770
Perm. max. weight lbs 2948
Curb weight lbs 2288
Perm. axle load front lbs 1144
Perm. axle load rear lbs 1837
101151
GKI9HE

PERFORMANCE

Top speed on an even roadway	approx. 70 mph
Top speed by water driving	approx. 7 mph

GEAR SPEEDS AT 4750 ENGINE R.P.M.

1 st	approx.	15.6 mph	(25 km/h)
2 nd	"	24.4 mph	(39 km/h)
3 rd	"	41.3 mph	(66 km/h)
4 th	"	70 mph	(115 km/h)

CLIMBING ABILITY

1 st	approx.	42%	
2 nd	"	26%	
3 rd	"	14%	fully loaded
4 th	"	7%	

FUEL AND LUBRICANT QUANTITIES

Fuel tank capacity	12,4 gall	
Reserve capacity	2,1 gall	
Engine	4 qts.	HD. engine oil
Gearbox	3,5 pts.)	
Water transmission box	1,75 pts.)	Gear oil SAE 90
Steering box	0,28 pts.)	

RECOMMENDED OILS

Temperature			
Above 80 F		SAE 30	10 W/30 or 20 W/40
30 - 80 F	use branded	SAE 20	10 W/30
Below 30 F	HD oils only	SAE 10	10 W/30
Below 10 F			5 W/20*

*. Use under extreme colder conditions.

POSITION OF MODEL IDENTIFICATION PLATES

Each vehicle is identified with an engine and chassis number. Both numbers are stamped in the identification plate, figure 1.

ENGINE NUMBER

This number is stamped in the engine block r/h side front, figure 2.

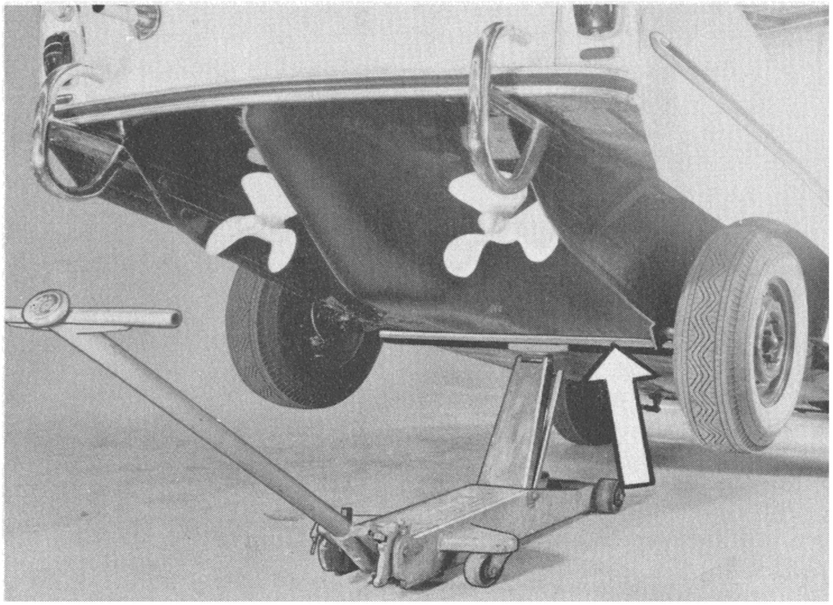
CHASSIS NUMBER

The chassis number is situated on the rear wall at the engine cover right side, figure 3.

When ordering spare parts please pay attention to the directions in the spare parts catalogue.

NOTE: All measurements of the engine are based on the English system.

The measurements of all other groups of the vehicle are based on the metric system.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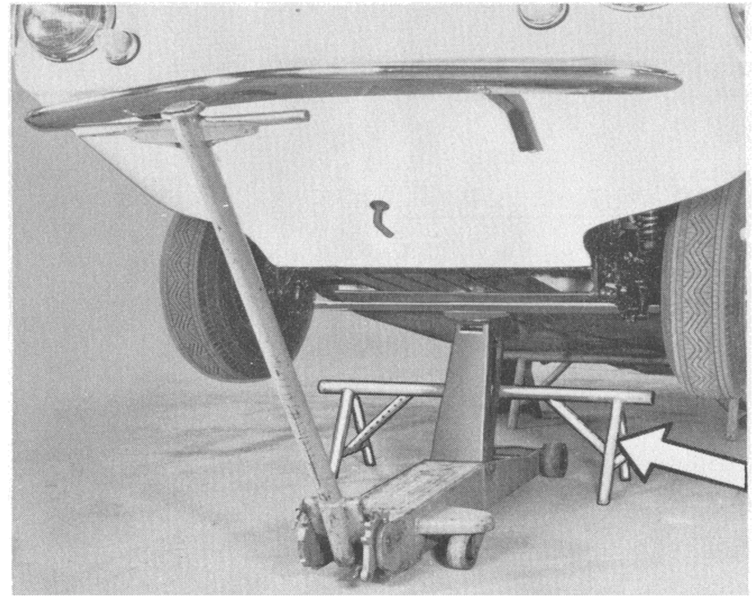
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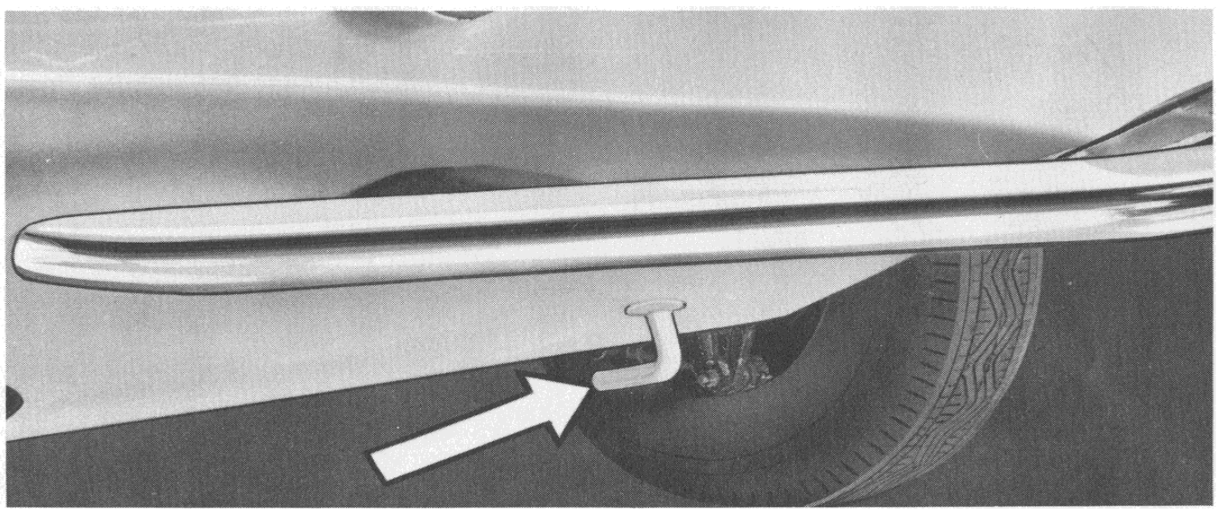
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GENERAL INSTRUCTIONS

It is most important to protect the vehicle body paintwork, interior trimmings, and seats from damage, before commencing repair work, by using protective plastic covers.

To ensure carrying out repair work on the AMPHICAR efficiently, the special tools as illustrated in the spare parts catalogue are very important.

Also it is important that all normal tools are in a good condition.

The repair workshop should be clean with good lighting conditions.

All dismantled parts should be cleaned and stored in a safe place, to avoid damaging.

Reconditioned units etc, must at all times correspond in performance and technically as by a new unit or part. This is only possible when all reconditioning replacement spare parts are original AMPHICAR.

Please pay attention to the instructions given in this workshop manual, for they are given from methods which have been proved to save time and high expenses.

RAISING AND TOWING

The floating body, being self-supporting with longitudinal and transverse stiffeners must be raised with the aid of an hydraulic transportable jack with a cross-member being the same length as the width of the floating body, to prevent damaging when raising (figure 1).

When raising the front of vehicle, position the cross-member under the front axle transverse stiffener (figure 2).

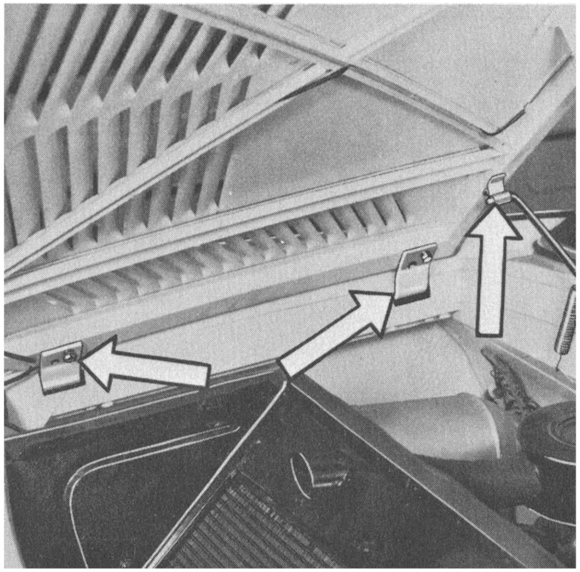
When raising the rear of vehicle position the cross-member under the rear axle (figure 1).

Should no cross-member be available, a thick wooden plank can be used.

By longer repair work it is advisable to place two strong metal stands under the floating body (figure 2) .

For towing purposes, is situated under the bow of the car a towing hook (figure 3).

Operations		Description	Specified torque range (lb. ft.)	Min. yield torque (lb. ft.)	Remarks
Cylinder head	3/8" UNF	nut	42-46	50	Tighten all cyl. head nuts after engine test
Cylinder head	3/8" x 4.28"	stud	10		
Clutch attachment	5/16" UNF x 5/8"	setscrew	18-20	20	
Connecting rod bolts		bolt	42-46	50	
Chain wheel attachment	5/16" UNF	setscrew	24-26	30	
Dynamo bracket to block	5/16" UNF x 3/4"	bolt	16-18	20	
Dynamo to engine plate	5/16" " x 27/8"	bolt	16-18	20	
Dynamo to mounting bracket	5/16" " x 1"	bolt	16-18	20	
Flywheel attachment	3/8" "	bolt	42-46	50	
Front engine plate & camshaft	5/16" " x 3/4	setscrew	18-20	20	
Locating plate to block	5/16" " x 7/8	bolt	18-20	20	
Fan to pulley	1/4" "	bolt	6-8	10	
Front engine bracket to front engine plate	5/16" "	bolt	18-20	20	
Gearbox and rear engine plate	5/16" " x 1,31"	stud	12-14	16	
Attachment	5/16" " x 3/4"	setscrew	14-16	20	
Manifold-exhaust outlet	5/16" " x 1,31"	stud	12-14	16	
manifold attachment	3/8" " x 1,34" 3/8" " x 1,84"	stud	24-26	30	
Main bearing caps	7/16" UNF x 3"	bolt	55-60	65	
Oil Gallery setscrews	5/16" " x 0,44	setscrew	18-20	20	Copper washer
Oil pump to block	1/4" " x 2 1/2"	bolt	6-8	10	
Petrol pump	5/16" " x 1 1/16"	stud	12-14	16	
Rear oil seal attachment	5/16" " x 1 1/8"	bolt	16-18	20	Aluminium seal
Rocker cover nuts	5/16" UNF x 4.13"	stud	1 1/2	16	
Rocker pedestal	3/8" " x 3.09"	stud	24-26	30	
Sump att to sealing block	5/16" " x 5/8"	sem s/screw	10-12		
Sump att to oil retaining cover	5/16" " x 5/8"	sem s/screw			Should maintain a minimum of 6 lb. ft. torque after a setting period
Sump attachment	5/16" " x 1"	bolt	16-18	20	
Sump attachment	5/16" " x 5/8"	setscrew	16-18	20	
Starter motor attachment	3/8" " x 1 3/4"	bolt	26-28	30	
Timing cover attachment	5/16" " x 3/8"	slotted setscrews		16	
Timing cover & front engine plate to block	5/16" "	bolt	14-16	20	
Water pump to combustion	5/16" "	bolt	18-20	20	
Water elbow to water pump	5/16" " x 1"	setscrew	16-18	20	



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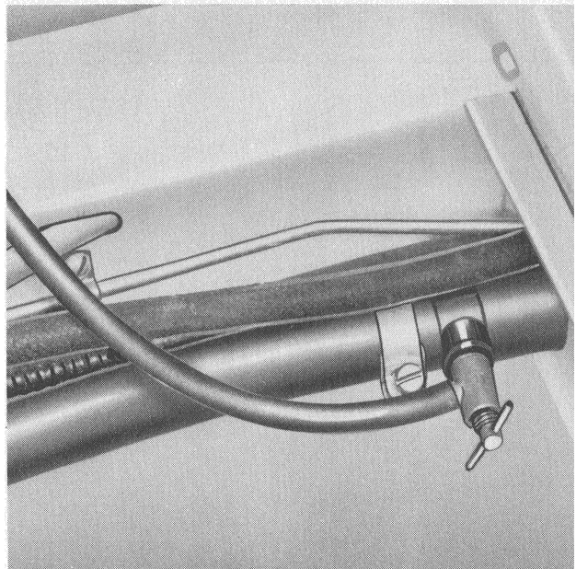

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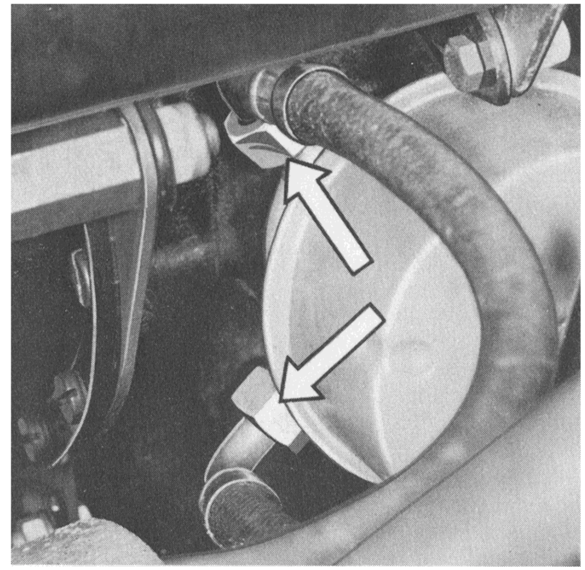

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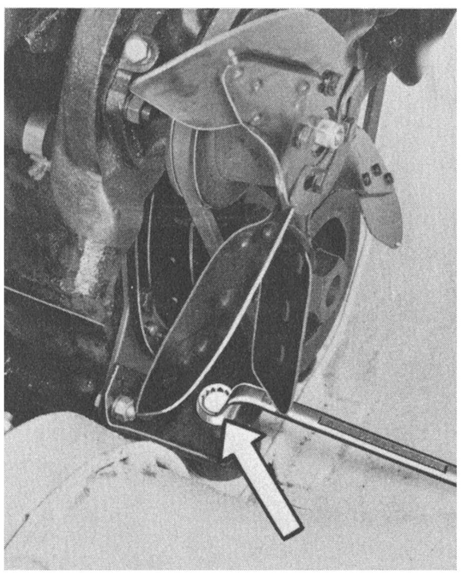

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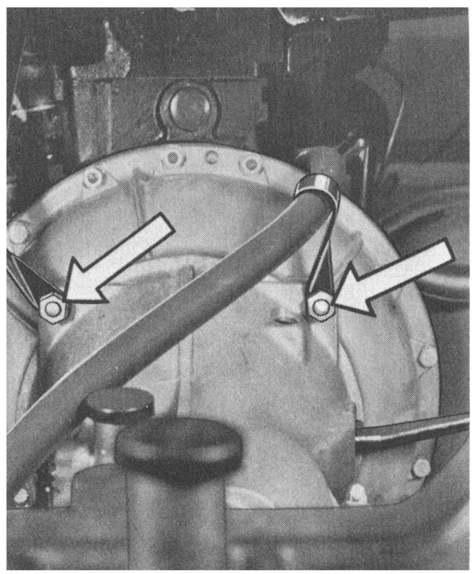

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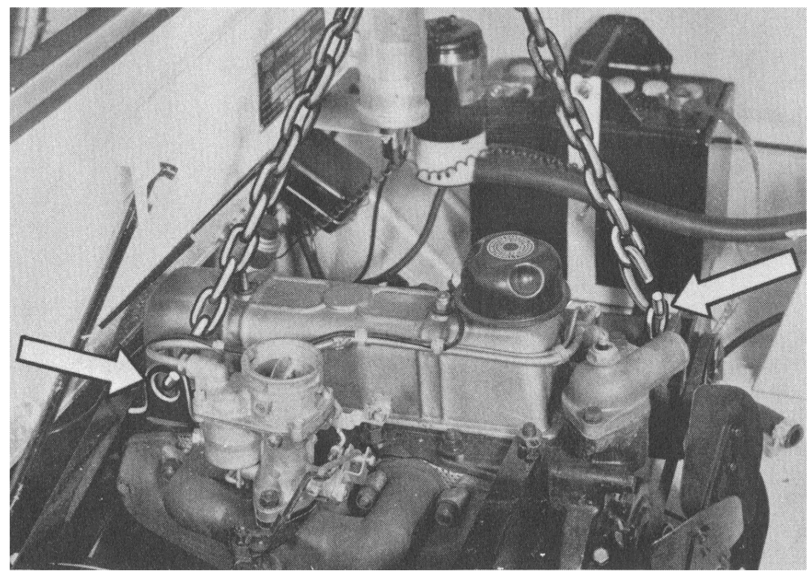

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GROUP 1. ENGINE

DESCRIPTION

The engine of the "AMPHICAR" is a water cooled, four stroke, four cylinder, Otto engine mounted at the rear of vehicle.

The following advantages are gained through being a rear mounted engine:

1. Equal distribution of weight on the axles, especially when leaving the water at difficult angles.
2. Great advantage between total and pay load, giving a very high driving comfort.
3. No long drive shaft, which means no vibration and less repairs.

The cylinder block and cylinder head are made from a special gray cast iron.

The counterbalanced crankshaft is running in three main journal bearings with bores for oil lubrication.

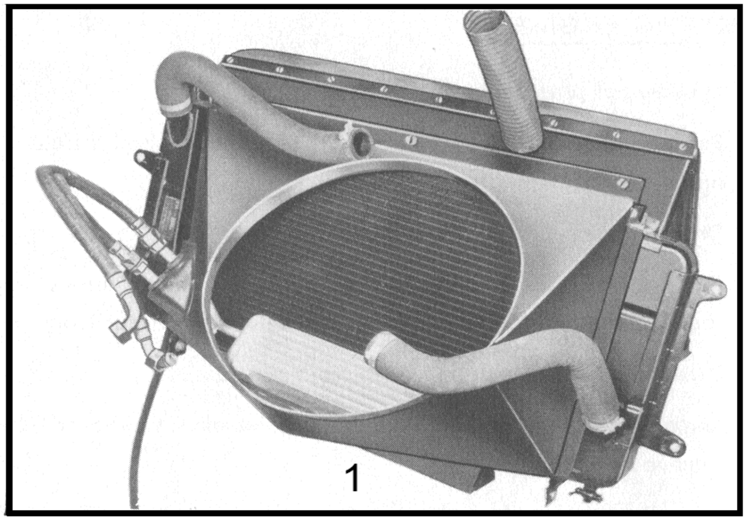
The valves are actuated by means of push rods and rocker arms, the camshaft being situated in the engine block and being driven by the crankshaft through a single-roller chain and chain sprockets.

The down-draught carburettor has a modified cold starting system, and the fuel is fed to the carburettor by a mechanical diaphragm fuel pump, being actuated from a cam mounted on the camshaft.

The vehicle has a 12 volt battery ignition, and starting of the engine takes place from an electric starter motor.

REMOVING ENGINE

1. Disconnect plus cable on battery.
2. Remove engine hood, by removing the bolts on both hinges (fig. 1), and disconnect electrical cables.
3. Drain cooling system, figure 2.
4. Remove radiator rubber hoses, both oil cooler hoses, figure 3, radiator fastening bolts, and finally remove radiator from vehicle.
5. Remove air filter together with fresh air hose.
6. Remove exhaust pipe end piece, and disconnect exhaust silencer and remove.
7. Unscrew and remove heater hose fastening brackets from engine block and rocker cover.
8. Disconnect the carburettor controls and pipe on the fuel pump.
9. Disconnect the temperature transmitter cable, starter motor cable, oil pressure valve cable, both cables on distributor, and finally both cables connected to the dynamo.
10. Remove both bolts with spring washers from the front engine mounting rubbers, figure 4.
11. Remove rear seat complete and seat base.
12. Unscrew the four fastening nuts with spring washers connecting engine to gearbox, figure 5.
13. Raise the engine out of the vehicle, with the aid of a pulley block tackle attached to the mounted lifting eye brackets, one situated on the dynamo, the other on the cylinder head, figure 6.
14. After removal clean the engine before finally placing on the working bench.



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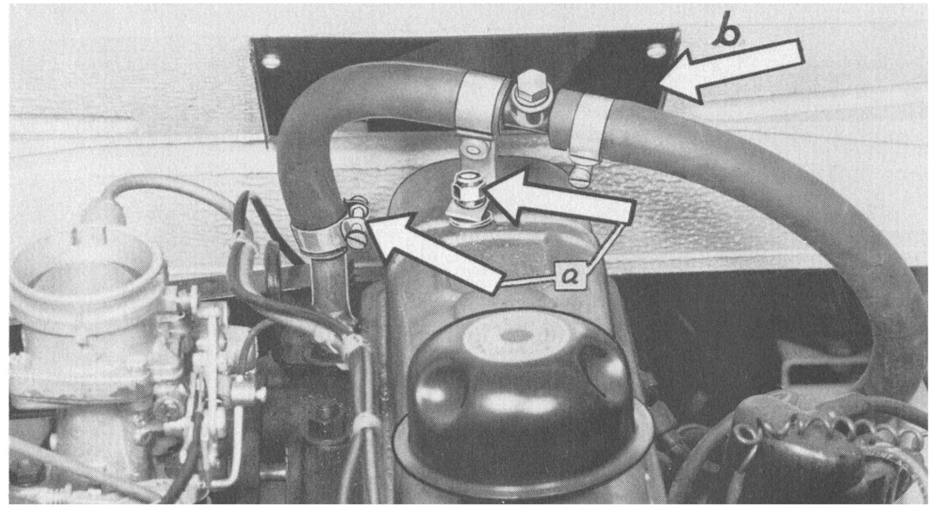

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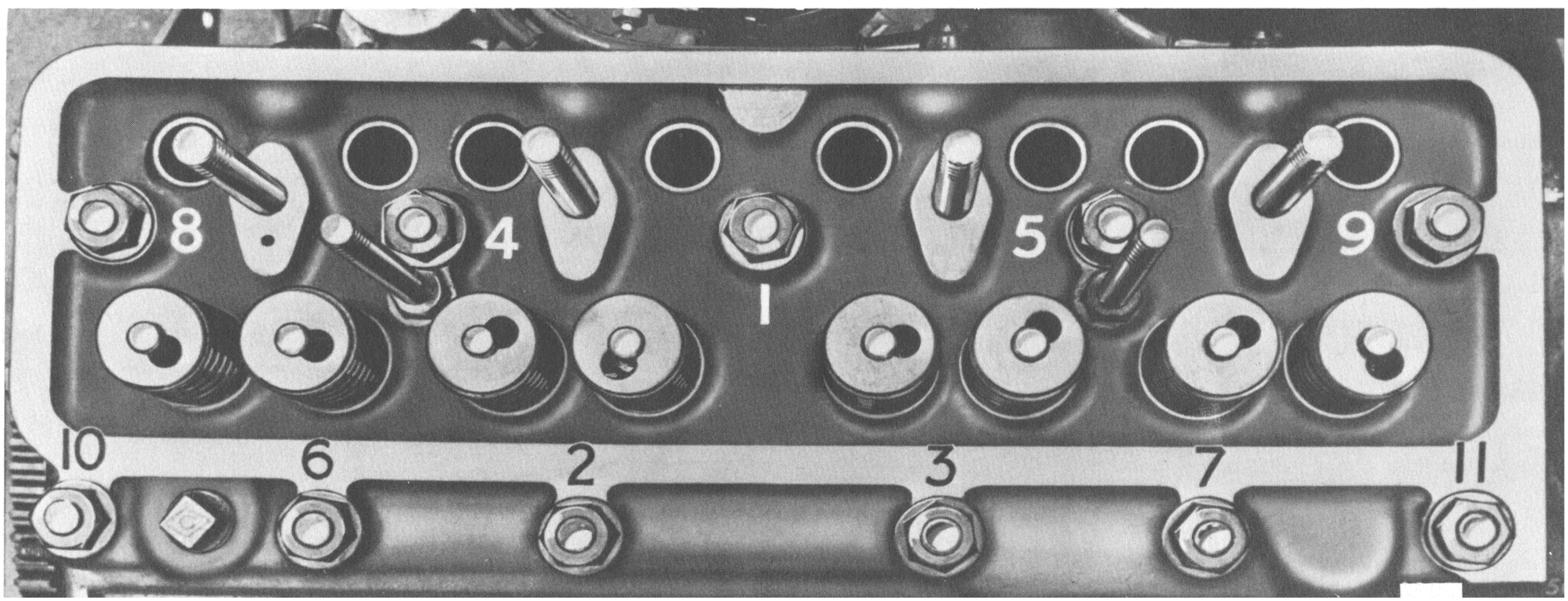

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DECARBONISING AND SERVICING OF THE CYLINDER HEAD AND ASSOCIATED PARTS

The cylinder head should be removed for decarbonising and valve grinding after approximately the first 5.000 miles (8.000 km). This is to give attention to the valves and seats which may have become distorted during the initial stabilizing of the metal. Subsequent attention should not be necessary until a further considerable mileage has been covered, usually about 15.000 miles (24.000 km). Even then, if all compressions are normal and the engine's performance is satisfactory, it is well to delay decarbonising until necessary.

REMOVING THE CYLINDER HEAD WITH THE ENGINE INSTALLED IN VEHICLE.

To carry out this work, proceed as follows:

1. Disconnect battery and drain cooling system.
2. Disconnect the top and bottom radiator hoses.
3. Remove the radiator (unscrew the four holding screws). Also disconnect the oil tubes connected to the oil cooler, figure 1.
4. Remove the air cleaner and intake hose.
5. Disconnect the fastening bracket of the heater hose from the cylinder head and unscrew the nut of the rocker cover, figure 2, "a".
6. Disconnect the carburettor controls, fuel feed pipe and distributor vacuum control pipe. Remove the return spring for throttle cable.
7. Remove exhaust:

   Unscrew and remove the three nuts on exhaust pipe flange.

   Remove the exhaust silencer.

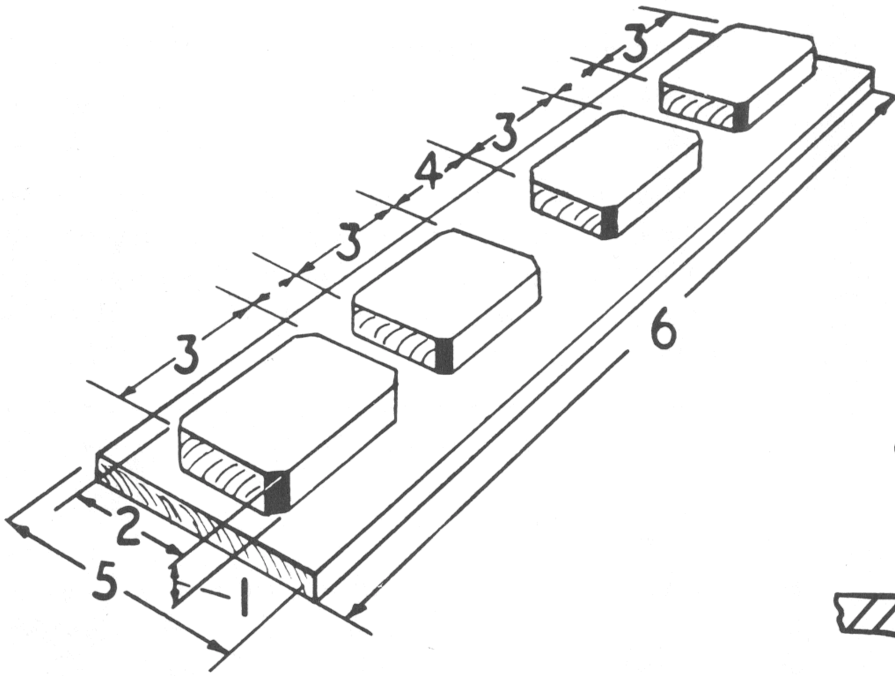
   Unscrew and remove the front and' rear mounting brackets.
8. Detach the temperature transmitter cable from thermostat.
9. Slacken the generator mountings, disconnect the adjusting link from the water pump, swing the generator inwards and remove the fan belt.
10. Remove the cover from engine partition, figure 2, "b".
11. Detach the rocker shaft assembly complete and withdraw the eight push rods.
12. By reversing the nut tightening sequence, shown on figure 3, starting from the highest number, progressively slacken the cylinder head nuts. Remove the cylinder head, complete with manifold and carburettor, by lifting it vertically from the securing studs, followed by the cylinder head gasket.
13. Place the cylinder head on the bench and remove the manifold, carburettor assemblies and gaskets.

REMOVING THE VALVES

Ensure that before removing the valves, they are suitably marked 1-8 (from front to rear) so that the valves are re-fitted to their original seats during re-assembly.

ENGINE

To facilitate removal of the valve springs, place the cylinder head over a rigid plate with blocks to support the heads of the valves whilst the springs are being compressed. Sufficient force can then be exerted with the fingers, or a tube wrench, to compress the springs and remove the retainers (137) springs (136) and the locating collars (135). By turning the cylinder head over, the valves may be withdrawn for inspection and servicing.



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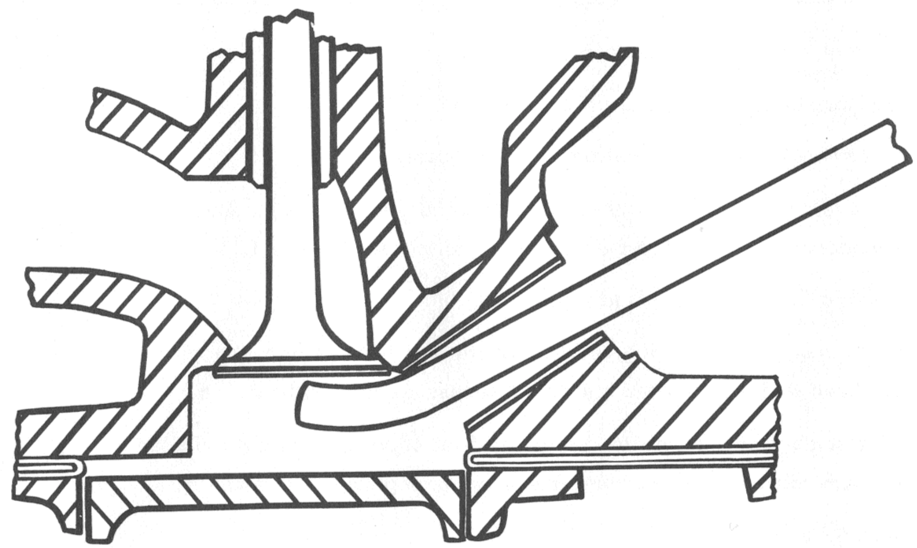

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REMOVING VALVE SPRINGS

If it is necessary to renew a valve spring without removing the cylinder head, turn the crankshaft until the piston is at T.D.C. and insert a steel bar bent as shown on fig. 2 through the sparking plug hole to support the valves. If difficulty is experienced in releasing the spring retainer from the valve stem, a sharp blow given to a suitably sized tube placed over the retainer will usually free this item.

(Figure 1 suggested spigot plate for supporting valve heads.)

DECARBONISING

CYLINDER HEAD

Using suitable scrapers or small power tools, remove carbon deposits from the combustion head surfaces and the inlet and exhaust ports. Thoroughly wash the head with petrol to ensure that all loose carbon is removed and dry off with a high pressure air line. Do not use abrasives of any kind to remove the carbon.

VALVES

Clean and polish each valve, then examine the stems for straightness and wear, and the faces for burns, pitting or distortion. Renew valves which are excessively worn, bent or too badly pitted to be salvaged by refacing.

When re-facing valves, perfect concentricity of the valve stem with the chuck or collet is of the utmost importance. Remove only sufficient metal as is necessary to clean up the valve face. If the head thickness above the seat edge is reduced to less than 1/32" (8 mm), the valve must be renewed.

IMPORTANT. No attempt should be made to clean up a burnt or badly pitted valve face by extensive "grinding in" of valve to seat, as the latter, being the softer of the two surfaces, will merely be ground away without rectifying the valve face.

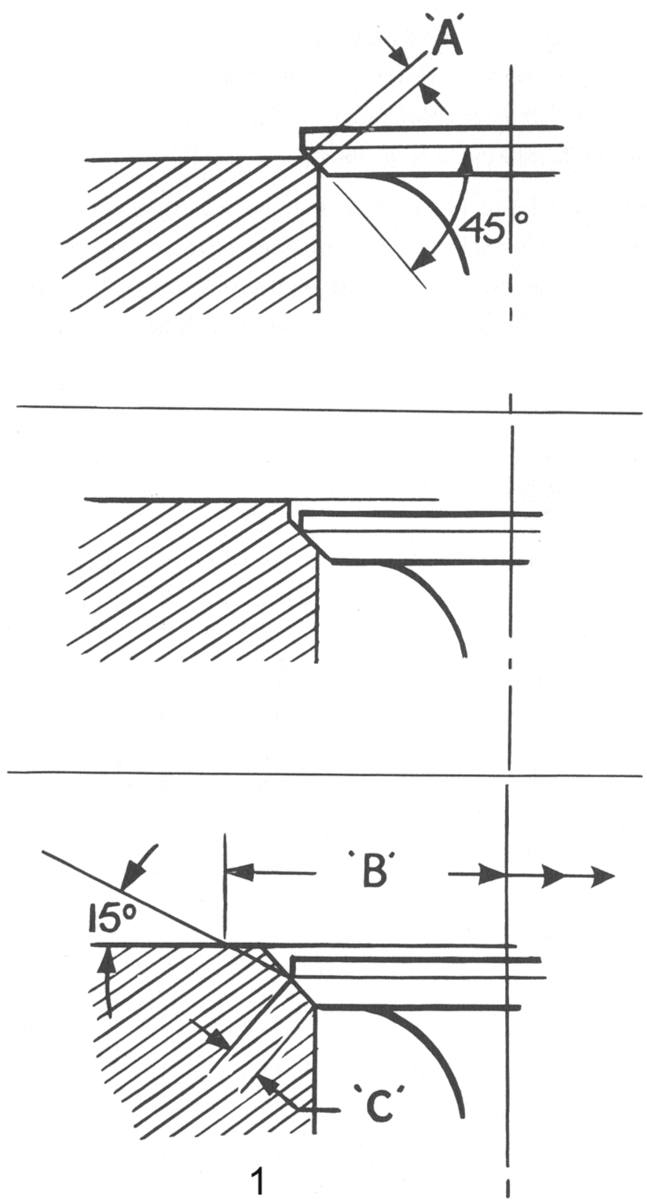
PISTONS

Before scraping the piston crowns, carefully clean the top of the cylinder block with petrol. To prevent the entry of carbon particles into the engine and the cylinder head oil feed drilling, cover all possible entry points with masking tape or rag.

Carefully remove the carbon from the tops of the pistons, leaving a ring of carbon around the outside of each piston crown at least 1/8" (3 mm) in width. An old piston ring placed in the top of the cylinder bore helps to maintain this carbon seal when decarbonising.

DIMENSIONS AND TOLERANCES

Parts and Descriptions	Dimensions new		Clearance new
	Ins.	mm	
Valve Springs			
Total number of coils	7 1/4		
Fitted Length	1.36	34.54	
Fitted load	27 to 30 lbs	12.25 to 13.61 kg	
Rate	150 lb/in.	68 kg/cm	
Solid length (max.)	0.93	23.62	
Valve guides			
length	2.25	57.15	
Bore	0.313 0.313	7.95 7.92	
Outside dia	0.502 0.501	12.75 12.72	
Press fit in cylinder head			
Amount valve guide	0.749	19.025	
Protrudes above cylinder head top face	0.751	19.075	



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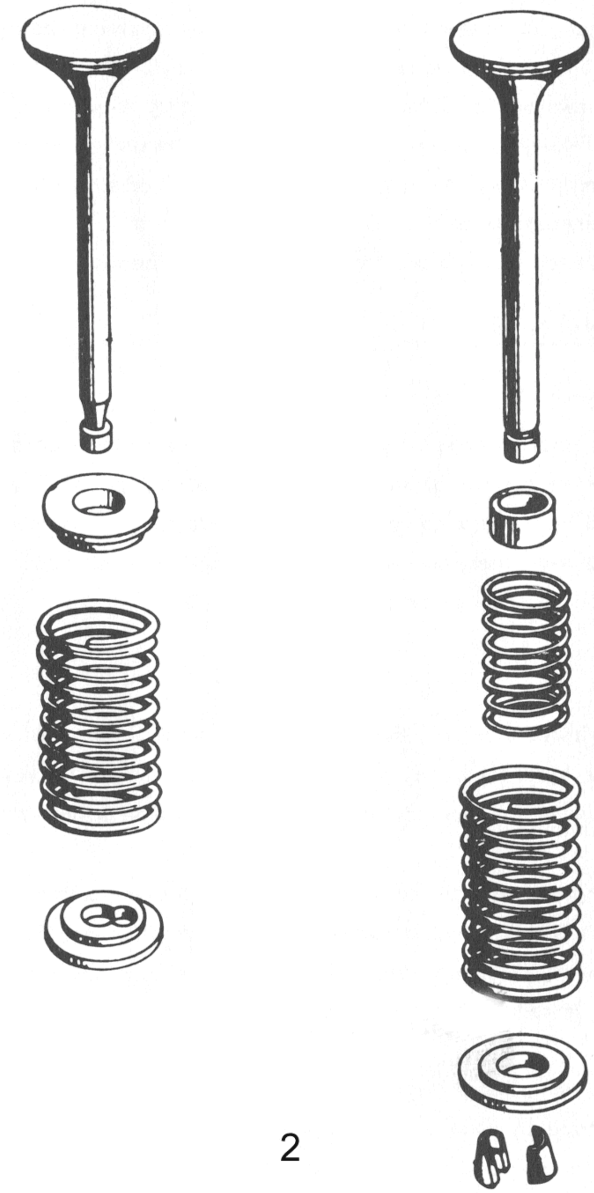

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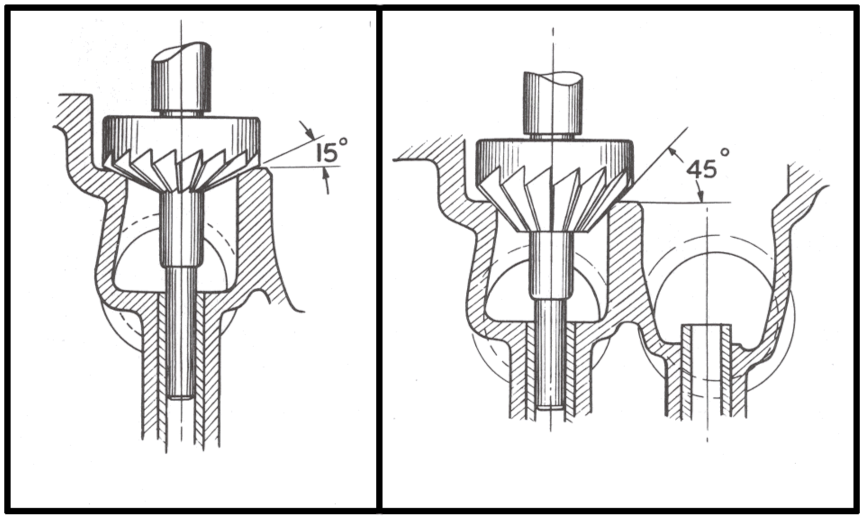
VALVE SEAT INSERT DIMENSIONS

	Insert Dimensions				Bore Out				Insert Part No.
	External Bore		Width		Diameter		Depth		
	ins.	mm	ins.	mm	ins.	mm	ins.	mm	
Exhaust	1.253	31.83	0.25	6.35	1.25	31.75	0.25	6.35	132242
	1.252	31.8	0.248	6.15	1.249	31.72	0.248	6.15	
Inlet	1.441	36.6	0.25	6.35	1.438	36.52	0.25	6.35	132241
	1.440	36.576	0.248	6. 15	1.437	36.5	0.248	6.15	

DIMENSIONS AND TOLERANCES

Parts and Description	Dimensions new		Clearances new	
	ins.	mm	ins.	mm
Valves				
Inlet valve head dia.	1.308 1.304	33.22 33.12		
Inlet valve stem dia.	0.311 0.31	7.89 7.87	0.001 0.003	.03 .08
Exhaust valve head dia.	1. 152 1. 148	29.26 29.16		
Exhaust valve stem dia.	0.309 0.308	7.85 7.82	0.003 0.005	0.08 0.13



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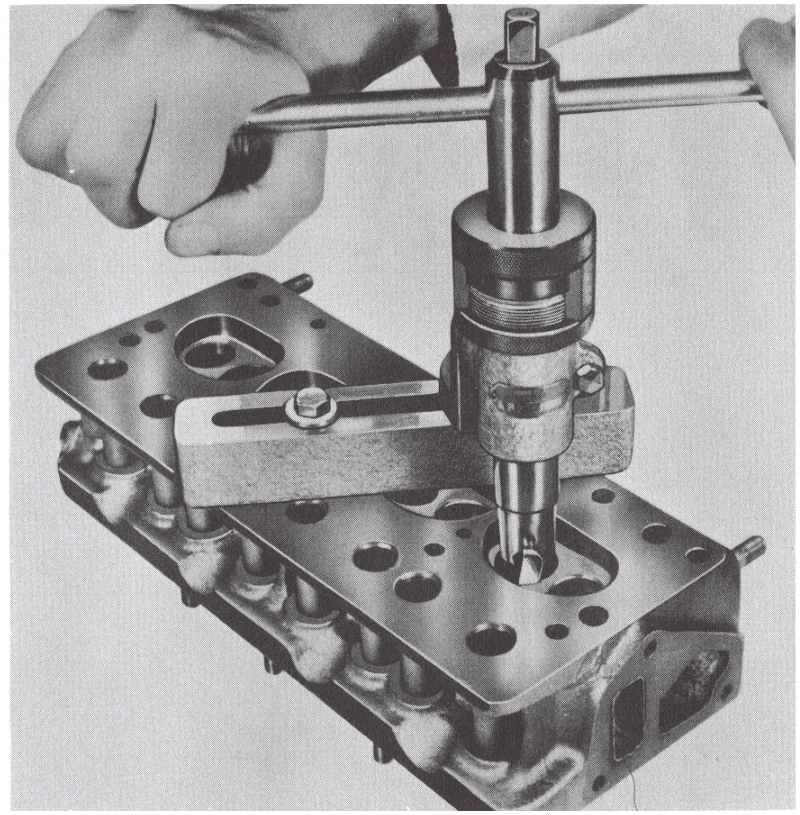

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SERVICING

VALVE GUIDES

Should excessive wear necessitate the replacement of valve guides, these must never be drifted in or out as the impact of the hammer blows may swell the guides and score their accommodating bores in the cylinder head.

The worn guides can be removed and the replacements fitted in one operation by utilizing the special tool. Where this tool is not available, the guides can be pulled out and replaced by use of a long screwed rod and a suitable arrangement of nuts, washers and tubing.

The valve guides should be drawn into position until the tops of both the inlet and exhaust valve guides protrude the requisite amount above the rocker cover joint face as illustrated.

VALVE SEATS

Carefully examine each valve seating for signs of pitting or burning and if such faults are present or if a new valve guide has been fitted, then the seat must be re-cut true to its guide.

Using a glaze cutter break through the hard glazed skin on the seat before using a 45-degree valve seat cutter, figure 1.

If a glaze cutter is not available, an old valve of correct size may be used with coarse grinding paste to break through the skin. Special care must be exercised to clean up the valve seat. Heavy pressure on the cutting tool will cause judder marks in the seat, thus necessitating an excessive amount of "lapping in" to remove them.

NOTE: The finished valve seat face must be concentric with the bore of the valve guide. The pilot of the facing tool should, therefore, be a close fit in the valve guide and without side play. (See valve guide replacement.)

When re-cutting the seats to the correct angle of 45 degrees, remove only sufficient metal to obtain a clean concentric face. If the width of the valve seat face exceeds 0.1" (2.5 mm) after cutting, then a 15-degree cutter and pilot must be used to reduce the width of the seat to 0.060" (1.25 mm). This is necessary to avoid "pocketing" of the valve, a condition which would impede the gas-flow.

When it becomes necessary to use a 15-degree cutter the outer diameter of the seat cut by it should never exceed 1.25" (31.75 mm) exhaust and 1.438" (36.52 mm) inlet. Any excess of these dimensions will render the head unsuitable for the fitting of valve seat inserts.

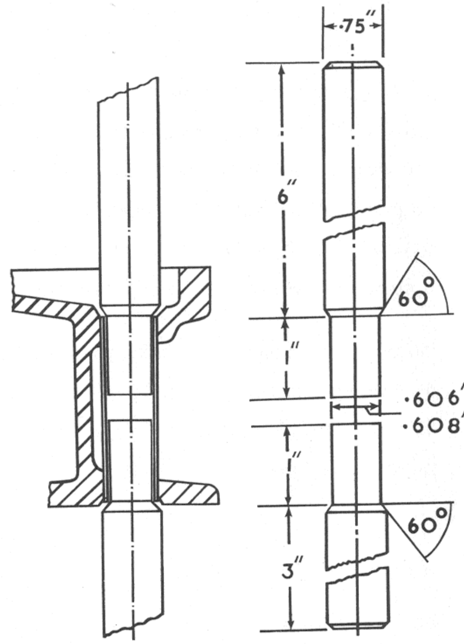
VALVE SEAT INSERTS

When valve seat wear has become more than can be corrected by the methods described under "valve seats", then it will be necessary to fit valve seat inserts.

To fit an inlet valve insert, use a 1.45" to 1.446" (36.83 to 36.73 mm) diameter cutter to remove metal from the side of the combustion chamber, figure 2. If both inlet and exhaust valve inserts are to be fitted, the inserts will overlap, therefore, fit one insert and bore into it when machining the recess for the second insert.

Having removed all swarf, lay the new insert over the recess in the cylinder head and press the insert squarely into place, using a pilot drift for this purpose and making sure that the insert is driven fully home.

Finally peen or roll the adjacent metal of the cylinder head over the slightly chamfered upper edge of the insert and re-face the insert as described under "valve seats".



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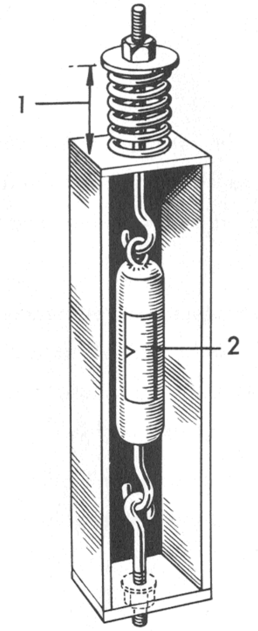

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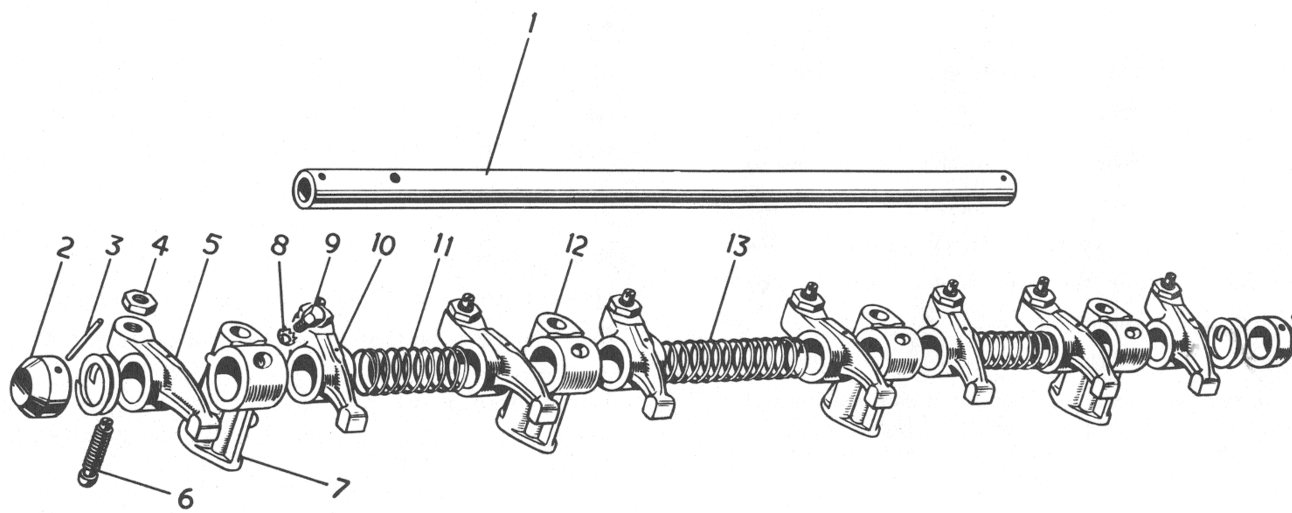


OIL LEAKS FROM PUSH ROD TUBES

Should an oil leak occur between the push rod tube and cylinder head, the leak may be cured by swaging the end of the tube into its countersunk face in the cylinder head.

The lower mandrel shown on fig. 1 should be held in a vice and the cylinder head supported over it whilst the upper mandrel is lightly tapped with a hammer as it is slowly rotated.

VALVE GRINDING

After all valves, guides and valve seats have received the attention necessary, each valve should then be finally ground into its seat by the normal "grinding in" process, using fine carborundum paste for this operation.

Continue the process until a narrow continuous seating has been obtained both on the valves and their seatings. Carefully wash the valves and seats to remove all traces of grinding paste and when dry, lightly smear the valve face with engineers' marking blue.

Insert the valve into its seating and rotate it not more than 1/8" (3 mm) in each direction. A complete circle should appear on the valve seating, thus indicating a satisfactory seal.

VALVE SPRINGS

Wash the valve springs and examine them for fatigue cracks and distortion.

If they appear serviceable, check their "free" lengths and their 'fitted' load, as shown on fig. 2. Spring data is given on page 17.

ROCKER SHAFT ASSEMBLY (FIGURE 3)

This is serviced as follows:

(A) To dismantle. Drift the mills pin (3) from a cap (2) at each end of the shaft (1) and remove both caps. Withdraw the locating setscrew (9) from the rear pedestal (7) and remove all components from the shaft.

(B) To assemble. Locate the rear pedestal on the shaft and, after aligning the locating hole in the shaft with the tapped hole in the pedestal, insert and tighten the setscrew. Assemble the remaining components as shown and insert a new mills pin through each end cap.

ASSEMBLY AND INSTALLATION VALVES

After carrying out all necessary operations on the cylinder head and associated parts, thoroughly clean all components. Lubricate each valve stem and guide with engine oil and re-fit the valves in their correct sequence.

VALVE SPRINGS

Single carburettor engine. Place the cylinder head on a spigot plate, fit the spring locating collars (135) followed by the valve springs (136) and finally secure the valves and springs with the retainers (137), pushing these on to the valve stems with the fingers, or by means of a suitable tube spanner.

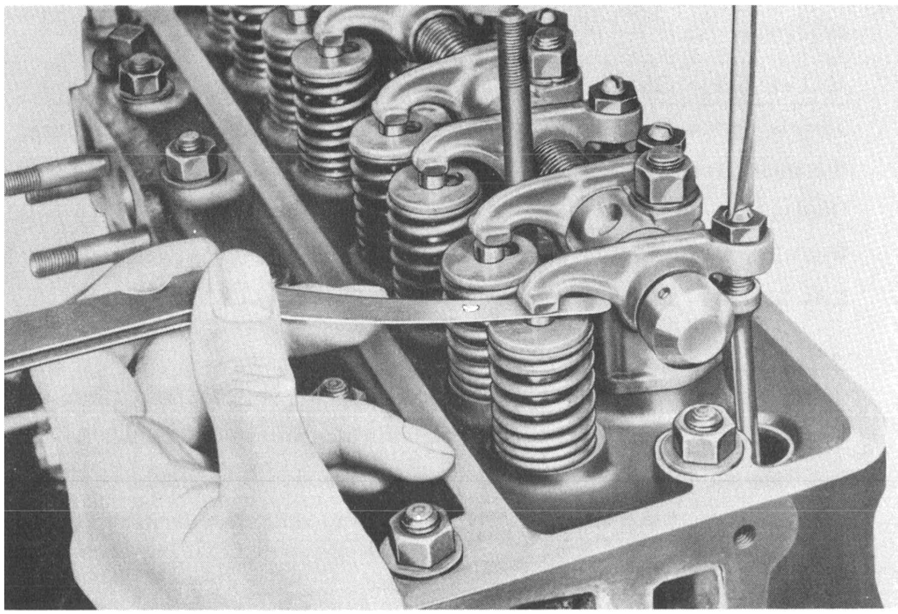
MANIFOLD

Remove all carbon from the inlet and exhaust manifold, and clean up the joint faces by careful scraping and the use of a wire brush. Re-fit the manifold to the cylinder head with a new manifold gasket between the faces. Secure the manifold with nuts, spring washers and bridge clamps.

CYLINDER HEAD

Stipple both sides of the cylinder head gasket with jointing compound. Clean the cylinder block face and lower the gasket over the studs.

Install the cylinder head and secure it with plain washers and nuts, tightening the latter to the correct torque and in the sequence shown on page 14. Note that the accelerator abutment bracket is attached to one of the cylinder head studs and the rear engine lifting eye is secured to the two r.h. rear studs.



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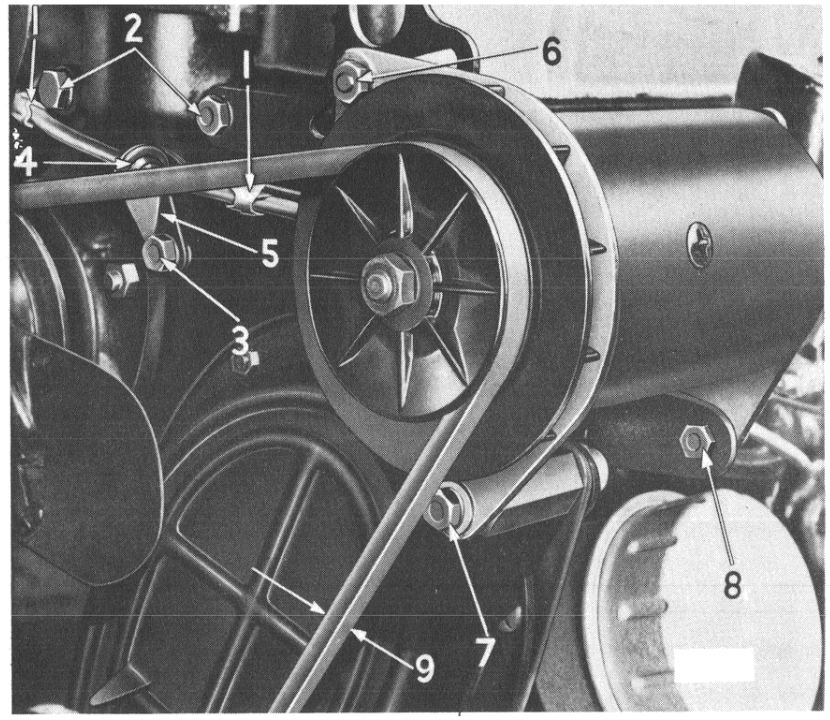

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VALVES

Working clearances (cold)	
- exhaust and inlet	0.010" (0.254 mm)
Clearances for valve timing	
- No.4 exhaust and inlet	0.040" (1.016 mm)
Valve seat angle	45º

When setting the rocker clearances, ensure that the tappet is resting on the back or rounded portion of the cam contour. This position is obtained by first turning the crankshaft until no. 1 push rod has reached its highest point, then rotating a further full revolution. After adjusting this rocker to the required clearance, treat each remaining rocker in a similar manner, figure 1.

Rocker clearances are: Inlet and exhaust 0.010" (0,25 mm) cold.

Ensure that the rocker cover joint washer is in good condition, attach the cover to the engine and secure it by fitting a fibre washer, plain washer and nyloc nut to each attachment stud.

Coat both sides of the water pump joint washer with jointing compound, and attach both this and the water pump to the cylinder head. Secure the generator adjusting link to the water pump by means of a bolt and spring washer (2). Fit the fan belt and tension this to give 3/4" (19 mm) side play at its longest run by swinging the generator outwards on its mountings and tightening the adjustment bolt. Do not attempt to lever the belt over the plastic generator pulley. Finally, tighten the generator lower mounting bolts.

Attach the drain pipe to the manifold securing the lower end of the pipe in the clip attached to the sump flange bolt (7) using a new gasket between the joint faces, secure the front exhaust pipe (60) to the manifold flange (5).

Clean the carburettor. jets and float chamber then re-fit the carburettor to the manifold, using a new insulating washer between the flange faces. Connect up the accelerator and choke cables ensuring that the choke control returns the strangler to the "off" position. Attach the fuel pipe and distributor vacuum pipe, securing these to the front of the cylinder block by means of clip (1) and a bracket (5) attached to the lower water pump bolt, (3), figure 2.

SPARK PLUGS

Lodge CNY 1/2" (12.7 mm) reach

8 : 1	0.025" (0.65 mm) gap.
6.8 : 1	0.030" (0.762 mm) gap.

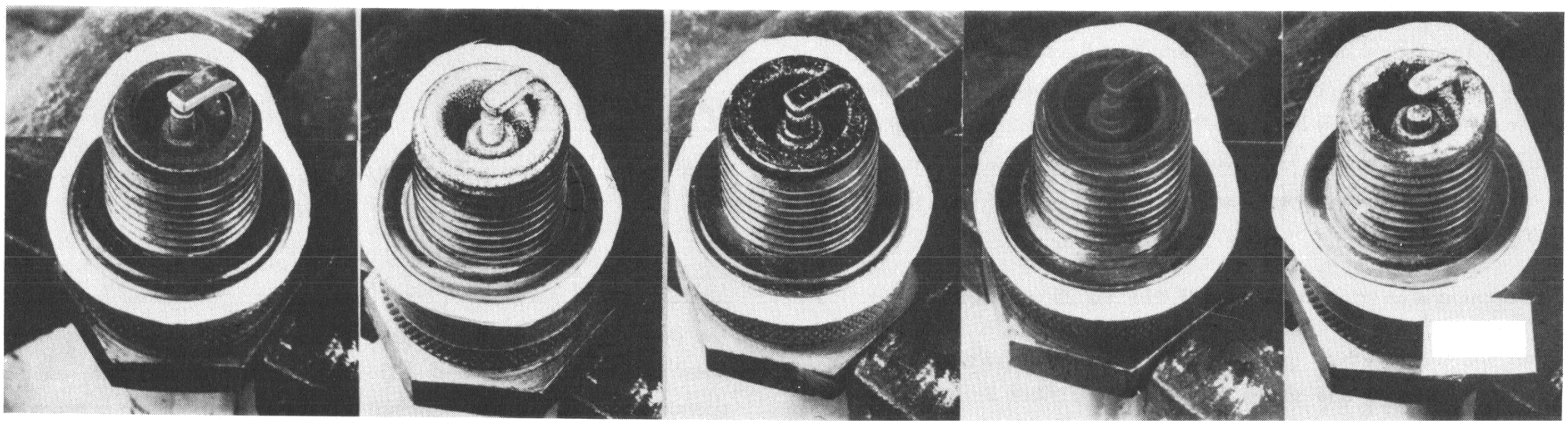
TESTING

The purpose of spark plug testers is (A) to locate any cracks or breakdown of the insulator and (B) to check on the pressure required to quench the spark at the points at a given voltage. There is a great deal of misapprehension about these testers and many plugs are discarded unnecessarily because the results obtained are misunderstood.

Connection is made to an electrical supply with a good earth, and to an air supply of not less than 100 p.s.i., preferably with a water trap.

Clean the plugs before testing and set the spark gap to 0.025" (.635 mm) by bending the earth electrode only. Screw the plug into the pressure chamber, using the appropriate thread adaptor. Lifting the operating arm until contact is made with the plug terminal completes the electrical circuit and sparking should then take place at the plug electrodes.

Increase the air pressure by rotating the air control; if sparking at the electrodes ceases when the pressure gauge pointer is in the red section of the scale the plug is faulty; if sparking continues or ceases when the pointer is in the yellow sector the plug is satisfactory.



A B C D E

It is possible that there will be insufficient pressure to quench the spark at all. This, of course, still indicates that the plug is sound provided there is sufficient pressure to bring the gauge needle into the yellow zone.

CLEANING AND RENEWAL

The life of spark plugs and the periods at which they should be cleaned varies with the condition of the engine and the work it performs. As a general recommendation, electrode gaps adjusted to 0.025" (.635 mm) every 3.000 miles, and the plugs renewed at 12.000 miles.

Fig. 1 provides an easy guide for identifying the various plug conditions.

Correct grade	Too hot running	Too cool running	Mixture too rich	Worn out plug
A	B	C	D	E

Smear the threads of new plugs with graphite grease to prevent the possibility of seizure and damage to the cylinder head. Incidentally, plugs should be screwed in with a torque wrench, but if this is not available use a tommy bar not more than 6 inches long.

H.T. CABLES

Re-connect the high tension leads to the spark plugs in the order shown on page 58. Renew any leads which have become chaffed or perished.

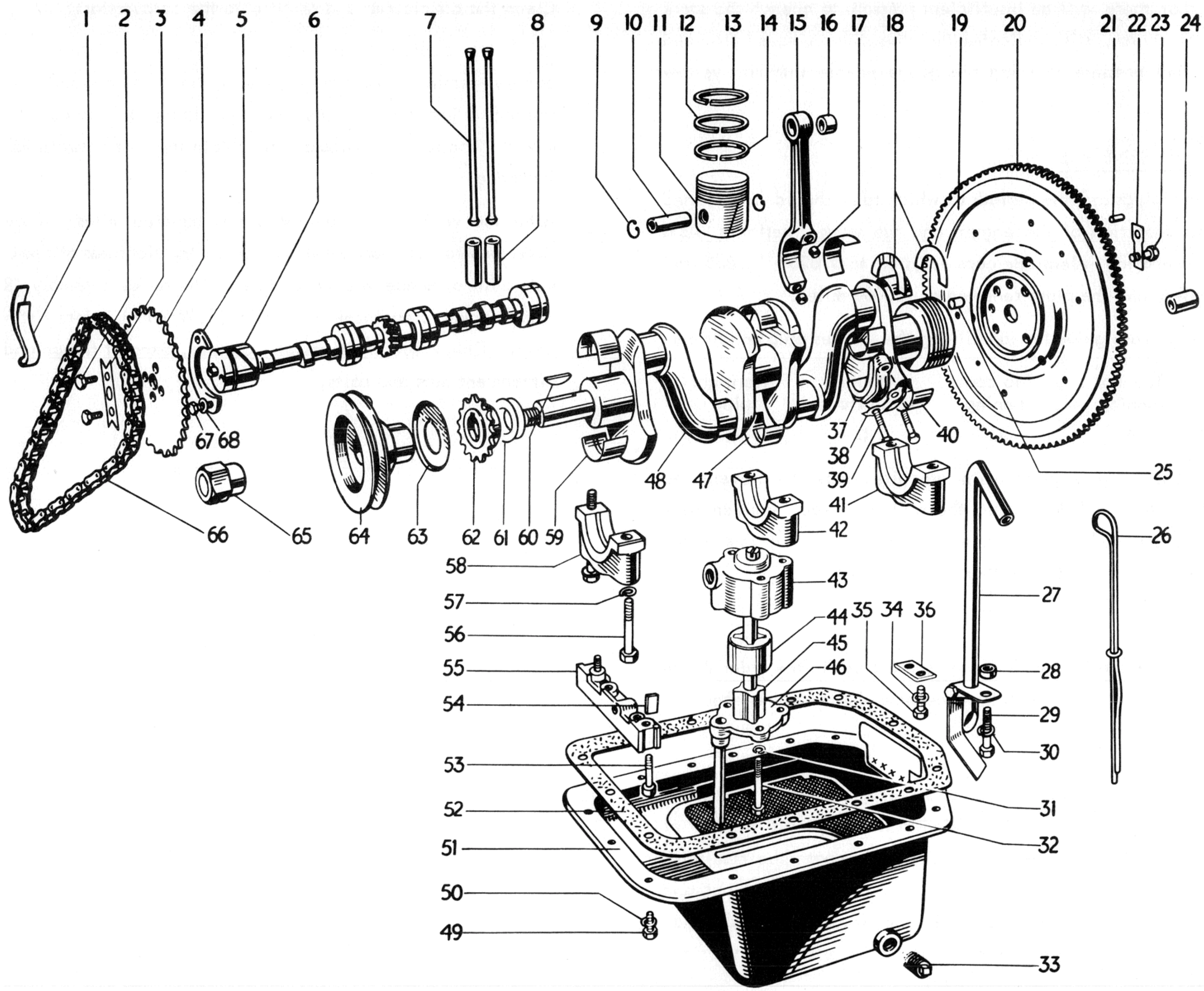
HOSES

Re-fit the top and bottom radiator hoses, securing them with hose clips. Similarly, re-connect the heater feed pipe to the adaptor at the rear of the cylinder head. Pass the heater return pipe beneath the manifold, attach the securing lug beneath the rear r.h. cylinder head nut and tighten the union nut into the adaptor in the water pump body. Reconnect the temperature transmitter cable to the lucar connector on the transmitter unit.

Clean the air cleaner and re-fit it to the carburettor.

Re-fill the radiator with water or anti-freeze mixture. Re-connect the battery terminal. Start the engine, warm it up and road test the vehicle, making adjustments to the ignition timing and carburettor idling and mixture controls as necessary to obtain the best possible idling and performance.

After the vehicle has covered a few hundred miles, remove the rocker cover and rocker shaft assembly, check the tightness of the cylinder head nuts with a torque wrench and re-fit the rocker assembly. Re-adjust the valve rocker clearances to 0.010" (0.254 mm) before fitting the rocker cover. Check the tightness of manifold, exhaust flange and water pump attachment nuts and bolts.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ENGINE DISMANTLING

Dismantle the engine by carrying out the following operations:-

Slacken the clip and remove the air cleaner.

Detach the retaining nuts (70), plain and fibre washers (71 and 72), then remove the rocker cover (73).

Progressively slacken and remove the nuts (139) and spring washers (138), then detach the rocker shaft assembly (75) .

Withdraw the push rods (7). Dismantle the rocker shaft assembly as described on page 23.

Disconnect the fuel pipe and vacuum ignition advance pipe at the carburettor and fuel pump and carburettor and distributor respectively. Remove the bolt from the top water elbow which also retains the fuel pipe clip and detach the pipes from engine.

Remove the nuts (2) spring washers (1) and detach the carburettor with gasket (3) from the manifold (5).

Remove the manifold drain pipe (6).

Remove the nuts (13 and 16), spring washers (14 and 17) and bridge clamps (15), then detach the inlet and exhaust manifold (5) and the gasket (18).

Slacken the generator attachment bolts, swing the generator inwards and remove the fan belt. Do not attempt to lever the belt over the plastic generator pulley. Remove the generator adjusting link generator pivot bolts (7 and 8), then detach the generator. Remove the bolts and spring washers, mounting (124), and detach the generator bracket (127) from the crankcase.

Remove the water pump attachment bolts and detach the water pump complete with gasket.

Detach the plug leads from the sparking plugs, slacken the clamp bolt and withdraw the distributor from the pedestal.

Remove the sparking plugs (131).

Reversing the sequence shown on page 14 slacken and remove the cylinder head nuts (134) and plain washers (133). Detach the throttle cable abutment bracket (3) and lift off the cylinder head (79) and gasket (84).

Dismantle the cylinder head components as described on page 15.

Remove the nuts and spring washers, then detach the fuel pump and gasket (98).

Unscrew and remove the oil filter.

Unscrew and remove the oil pressure switch (99) .

Remove the domed plug (103), copper washer (102), spring (101) and oil pressure relief valve plunger (100) .

Suitably wedge the flywheel and remove the crankshaft pulley retaining nut (65). Remove the crankshaft pulley (64) .

Remove the screws (118), bolts (119) and spring washers (120), then detach the timing cover (122) and gasket (123).

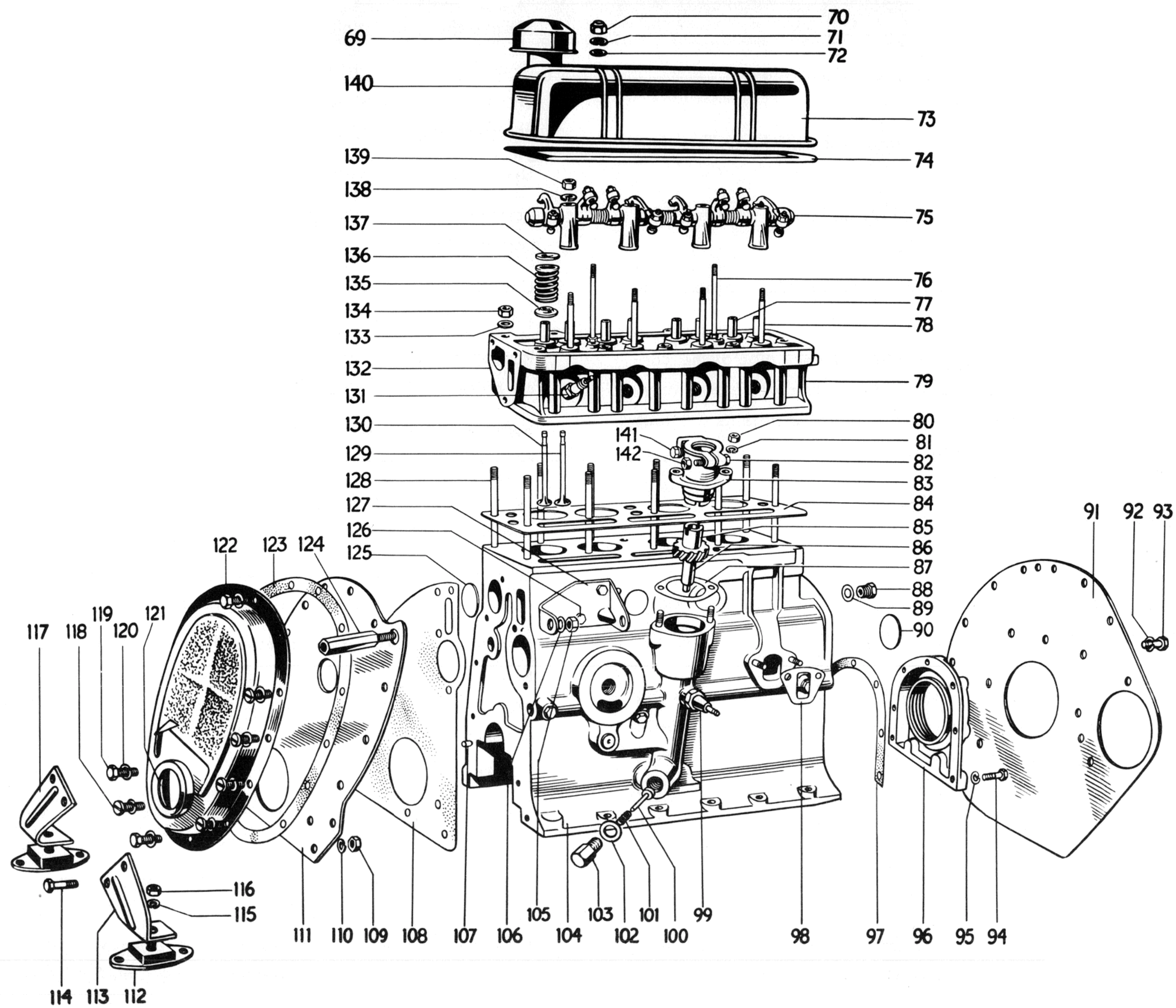
Remove the chain tensioner (65) from the cover by springing one blade over the pivot pin. Drive out the oil seal (121).

Release the lock tab (2), remove the bolts (1) and detach the camshaft timing sprocket (3) and chain (6). Lift the tappets (8) from the cylinder block, remove the bolts (67) with spring washers (68) and detach the camshaft retaining plate (4). Withdraw the camshaft from the cylinder block.

Remove the bolts (114) and detach the engine front mounting feet (113 and 117) from the front engine pi ate (111).

Release the retaining bolts and spring washers, then detach the front engine plate (111) and gasket (108).

Progressively slacken and remove the setscrews and spring washers, then detach the clutch unit and driven plate from the flywheel.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Release the lock tab (22), slacken and remove the bolts (23) and detach the flywheel (20).

Remove the bolts (93), spring washers (92) and detach the rear engine plate (91).

Invert the cylinder block and remove the sump attachment bolts (49) and spring washers (50) .

Remove the engine breather pipe (27) and the manifold drain pipe clip (36) secured beneath two of the bolts. Lift off the sump (51) and sump gasket (52).

Remove the bolts (94), spring washers (95) and detach the oil return scroll (96), followed by the gasket (97).

Remove the screws (53) and detach the front sealing block (55).

Release the lockplates (38). Remove the bolts (39) and detach the connecting rod big end caps (37) .

Withdraw the pistons (11) and connecting rods (15) through the cylinder bores. Detach the connecting rod shell bearings and refit the big end caps to their respective connecting rods.

Using circlip pliers, remove the piston pin circlips (9) and press the piston pin from each piston and connecting rod.

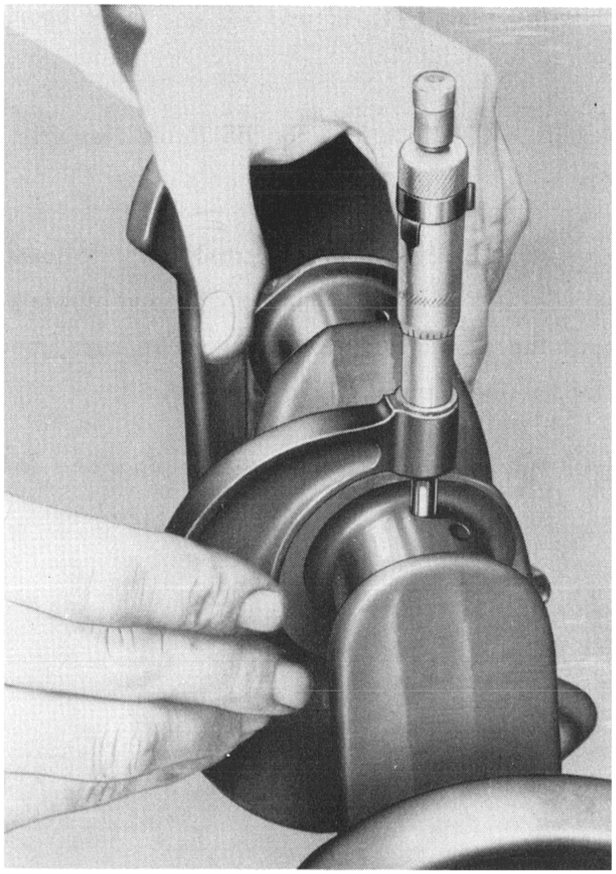
Detach the compression rings (13) and oil control rings (14) from each piston.

Remove the main bearing cap bolts (56) and spring washers (57), then detach the main bearing caps (41, 42 and 58) and lower bearing shells (40,47 and 59).

Lift out the crankshaft (48), followed by the thrust washers (18) and upper bearing shells.

Remove the timing sprocket (62) from the crankshaft, followed by the shims (61). By use of a 0.5" (12.7 mm) dia shaft, and grease packed in the bushing, extract the constant pinion shaft oilite bush from the rear of the crankshaft by striking the shaft with a mallet.

Complete the dismantling by removing all studs, plugs and dowels from the crankcase.



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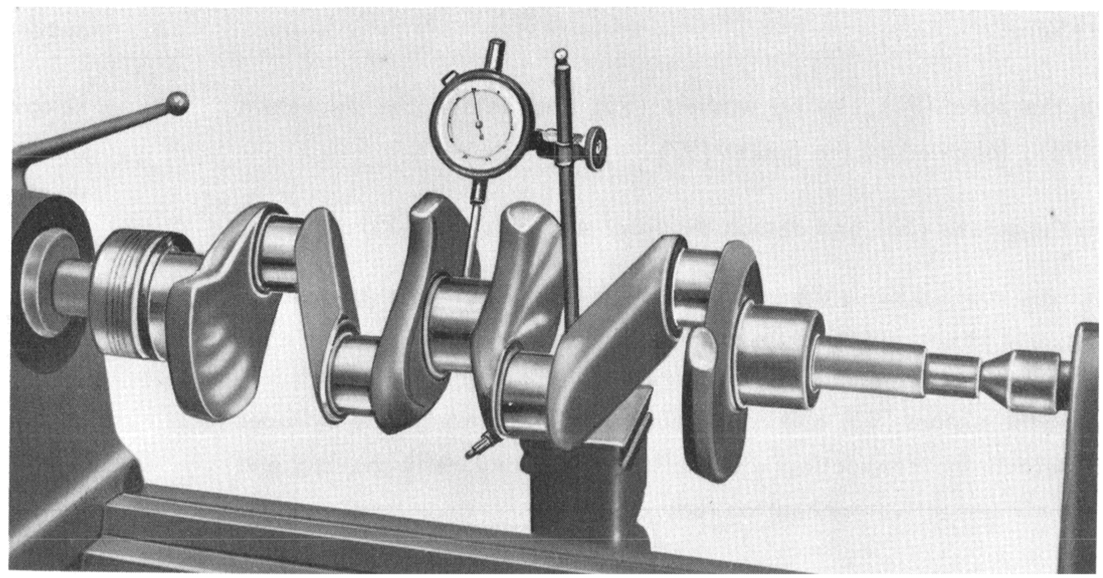

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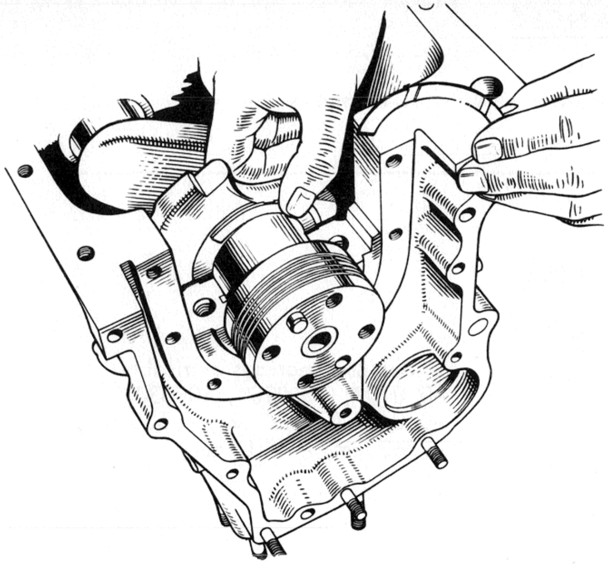
DIMENSIONS AND TOLERANCES

Parts and Description	Dimensions new ins.	Dimensions new mm	Clearances new ins.	Clearances new mm	Remarks
CRANKSHAFT					
Main bearing journal dia.	2.0005 2.001	50.81 50.83	0.0005 to 0.0032	0.0020 to 0.0813	
Main bearing internal dia.	2.0015 2.0037	50.84 50.89			Undersize bearings available: -0.010", -0.020", -0.030",-0.040" (-.254 mm, -.508 mm,-.762 mm, -1.016 mm).
Main bearing housing int. dia.	2.1460 2.1465	54.51 54.52			
Rear journal width	1.2995 1.2975	33.01 32.95			
Rear main bearing housing	1.2855	32.65	0.006 to 0.014	0.152 to 0.3556	
Width plus thickness of two thrust washers	1.2915	32.8			0.004" to 0.008" preferred.
Thrust washer thickness	0.091 0.093	2.31 2.36			
Oversize thrust washers	0.096 0.098	2.44 2.49			
Main bearing width	0.995 1.005	25.273 25.527			
Crank pin dia.	1.6255 1.6250	41.28 41.27	0.0005 to 0.0020	0.0127 to 0.0508	
Big end bearing internal dia.	1.627 1.626	41.32 41.3			Undersize bearings available: -0-010", -0.020", -0.030", -0.040", (-.254 mm, -.508 mm, -.762 mm, -1.016 mm).
Big end bearing width	0.692 0.682	17.58 17.32			
Crank pin width	0.9085 0.9086	23.076 23.078			



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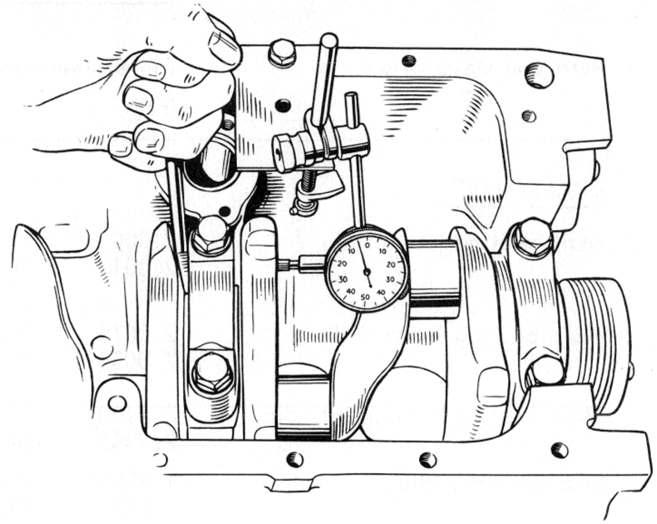

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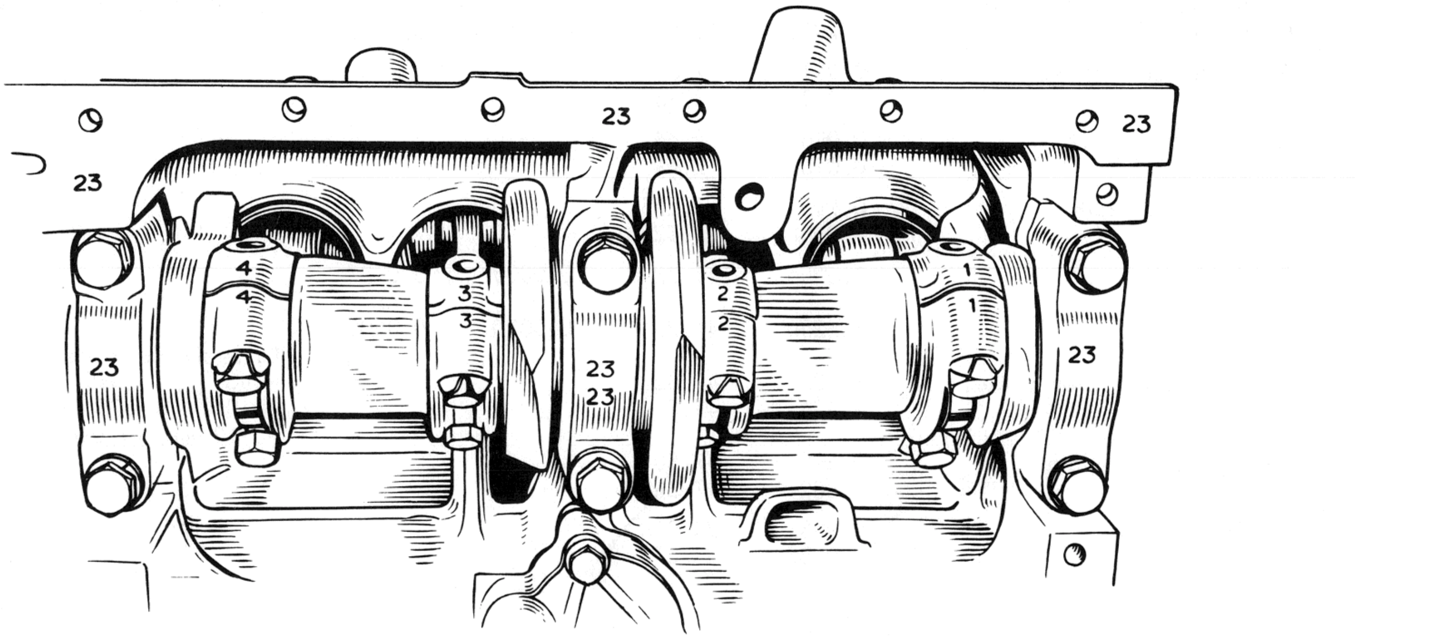

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ASSEMBLY OPERATIONS

DISTRIBUTOR DRIVE GEAR BUSH

Excessive wear in the drive gear bush is indicated by rocking the distributor shaft when partly withdrawn from the bush.

Excessive side movement of the shaft indicates the need for renewal of the bush, as follows:

Using a suitable diameter stepped drift, drive out the old bush from below and fit a new one from above, ensuring that the bushing flange goes fully home against the cylinder.

CRANKSHAFT REGRINDING

Crankshaft end float is controlled by the flanks of the rear main journal. The flanks of the front and centre main journals run clear of the bearing shells. Axial alignment of the crankshaft relative to the con-rods and pistons is, therefore, dependent on the rear main bearing.

If it is necessary to regrind the rear journal flanks, then an equal amount should be removed from each, and when ground, the distance between the flanks must not exceed 1.2995" (33.01 mm). This is the maximum amount which oversize thrust washer can accommodate, figure 1.

BALANCE

The crankshaft should be dynamically balanced. When balanced on knife edges, the maximum "out of balance" should not exceed 1/2 oz. ins.

RUN-OUT

When the crankshaft is mounted between centres, the maximum permitted run-out of the centre journal must not exceed 0.001" (0.25 mm) total indicator reading. The reading also applies to the run-out the periphery and rear face of the flywheel mounting flange, figure 2.

UNDERSIZE BEARINGS

These are supplied for servicing purposes in the undersizes stated in the technical data.

GRINDING FINISH

All pins and journals to have a ground surface finish of 7.12 micro inches and to extend over the whole fillet radius.

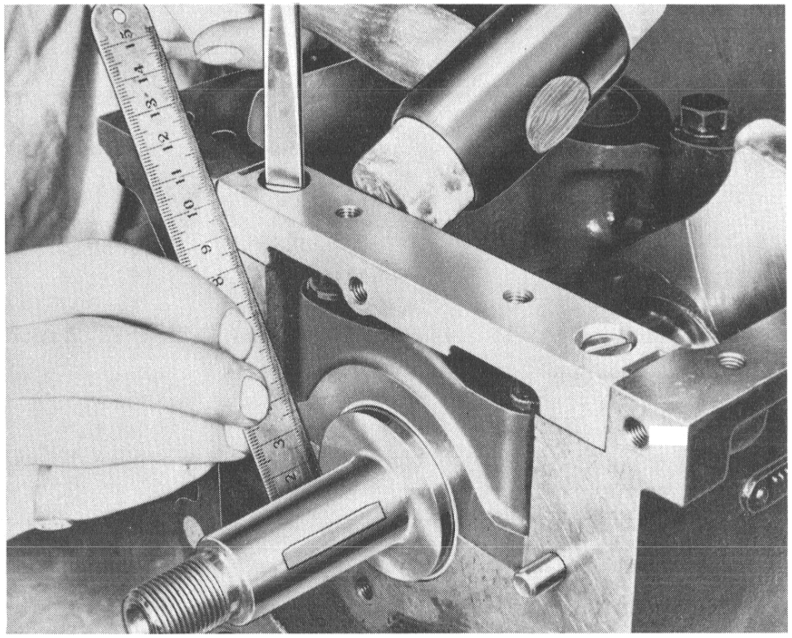
CRANKSHAFT INSTALLATION

Lubricate and position the main bearing shells in the crankcase, taking care to properly locate their tags in the recesses provided. Blowout the oil-ways in the crankshaft with compressed air, clean all journals and position the shaft in the crankcase.

Lubricate the two semi-circular thrust washers and pass these around the rear crankshaft journal. It is important that the grooved white metal faces bear against the crankshaft.

The main bearing caps are not interchangeable and must not be filed to take up bearing wear. The identification numbers on the caps must correspond with those on the oil sump face of the crankcase. Whilst the front and centre bearing caps appear identical, the latter is distinguished by being double stamped, as shown on figure 3.

Lubricate and fit the main bearing shells into the caps, then install the caps in the crankcase, taking care that they occupy their correct positions, and secure with the main bearing bolts and spacing washers. To prevent oil leakage, the front and rear caps must be tapped into alignment with the machined faces of the crankcase. Finally tighten the bolts to the correct torque.



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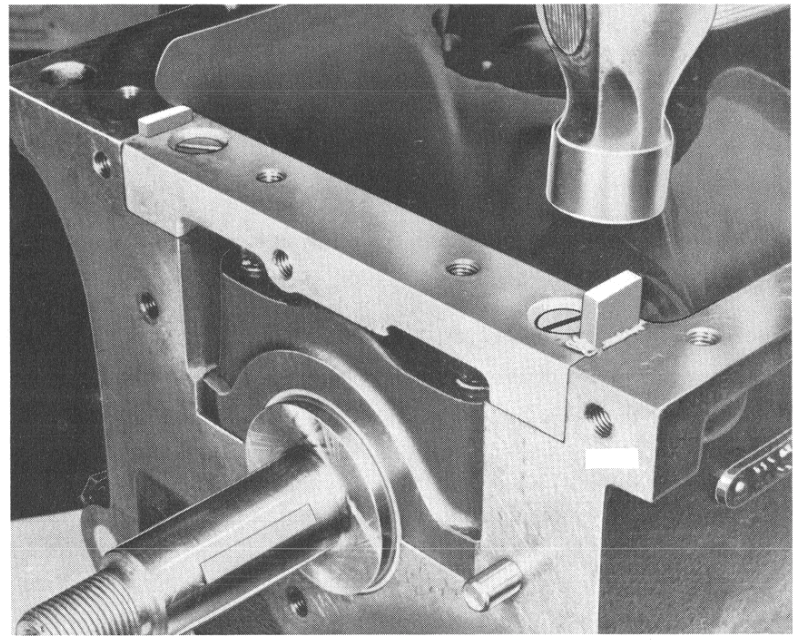

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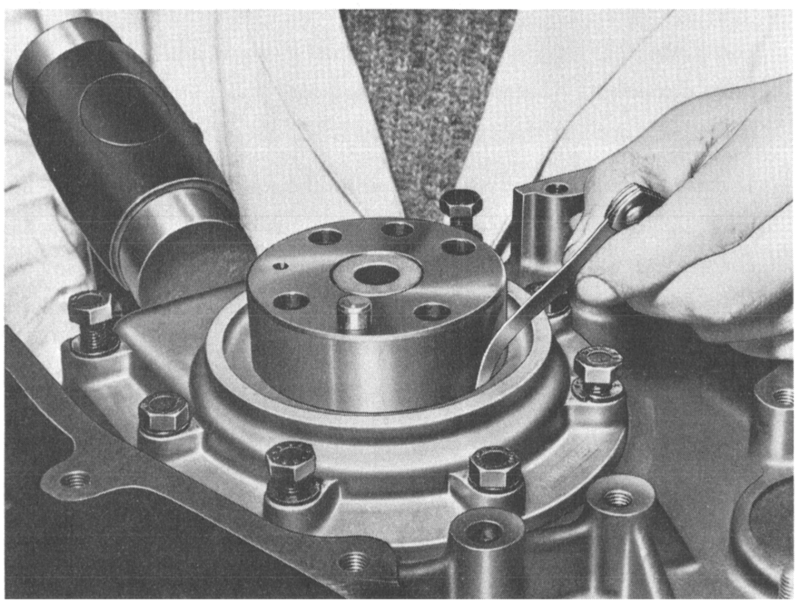

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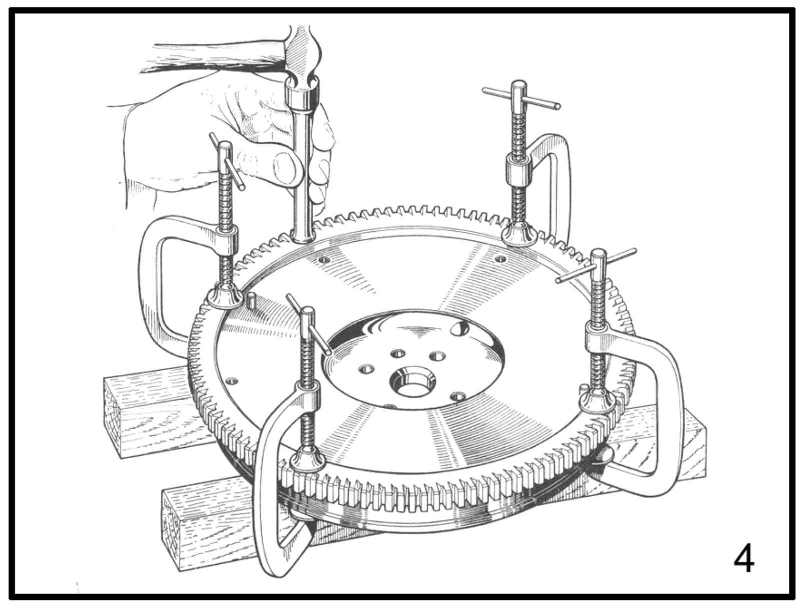

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Check the end float of the crankshaft; this should be 0.004" - 0.008" (0.1 - 0.2 mm). If the end float is excessive, correct it by fitting oversize thrust washers.

FRONT SEALING BLOCK AND BEARER PLATE. FIGURE 1 AND 2.

Using "wellseal" jointing compound on the joint faces, fit the front main bearing sealing block and during the tightening process, align the front face of the block with the machined face of the crankcase. Tap the wood filler pieces into the end recesses of the block and trim the excess material level with the oil sump face of the crankcase.

Fit the two dowels to the front of the crankcase, attach the front bearer plate and greased paper joint washer and secure with appropriate bolts and spring washers.

REAR OIL RETURN SCROLL AND BEARER PLATE. FIGURE 3.

Position a new paper joint on the rear face of the crankcase with grease and lightly bolt the rear oil return scroll to this face. Insert a feeler gauge of approximately 0.003" (0.076 mm) thickness and tap the return scroll until equal clearance between the crankshaft and oil scroll has been obtained all round. Finally, tighten the bolts to the correct torque and re-check clearance.

Insert two dowels in the rear crankcase face, position the rear engine bearer plate and secure this with bolts and spring washers. Insert the input shaft spigot oilite bushing into the rear of the crankshaft and rotate the latter to bring numbers one and four crankpins to T.D.C.

FLYWHEEL

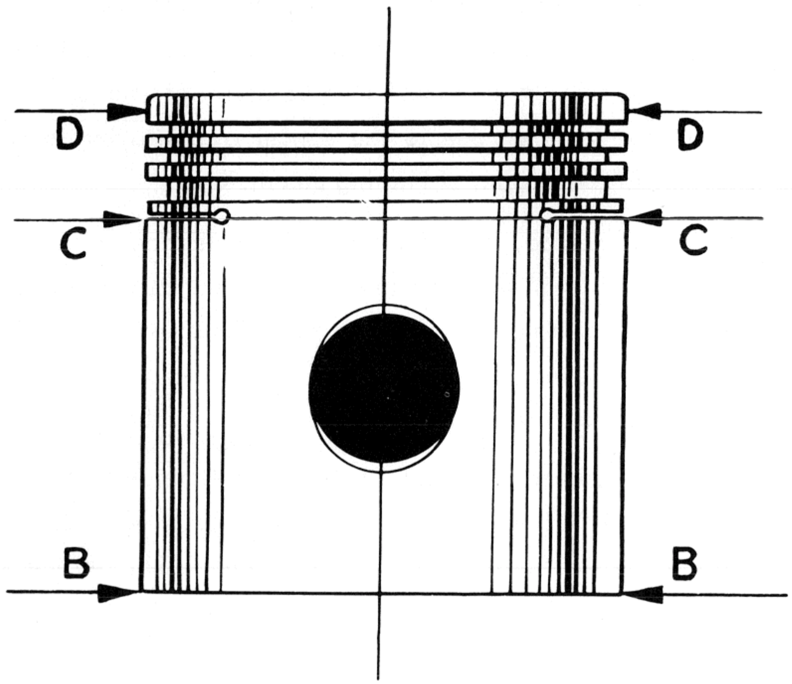
REPLACING STARTER RING GEAR

The starter ring gear is an interference fit and is shrunk onto the flywheel during initial assembly. If damaged or unserviceable, it can be removed with a copper drift whilst the flywheel itself is supported on blocks sufficiently thick to raise the ring gear above the bench surface.

The new gear is fitted by first heating it and then locating it on the cold flywheel. If heated to a sufficiently high temperature the expansion of the gear will be such as to enable it to be easily positioned on the flywheel, but unfortunately, due to the danger of destroying its hardness, there is alignment to the amount of heating permissible.

A recommended method, free from the afore-mentioned danger, is to immerse the gear ring in boiling water for at least ten minutes. Then, by use of a fly press or a number of "G" clamps, as shown on fig. 4, carefully press the gear into position of the flywheel. To avoid loss of heat this operation must be carried out with the least possible delay.

Attach the flywheel to the end of the crankshaft with the flywheel timing mark also at T.D.C. This should automatically occur if the dowel in the end of the shaft has located in the flywheel. Tighten the securing bolts, but before locking the tab washers, check the flywheel clutch face for run-out. If the maximum tolerance of 0.003" (0.076 mm) is exceeded, then the cause must be established and corrected, after which the tab washers can be finally locked up.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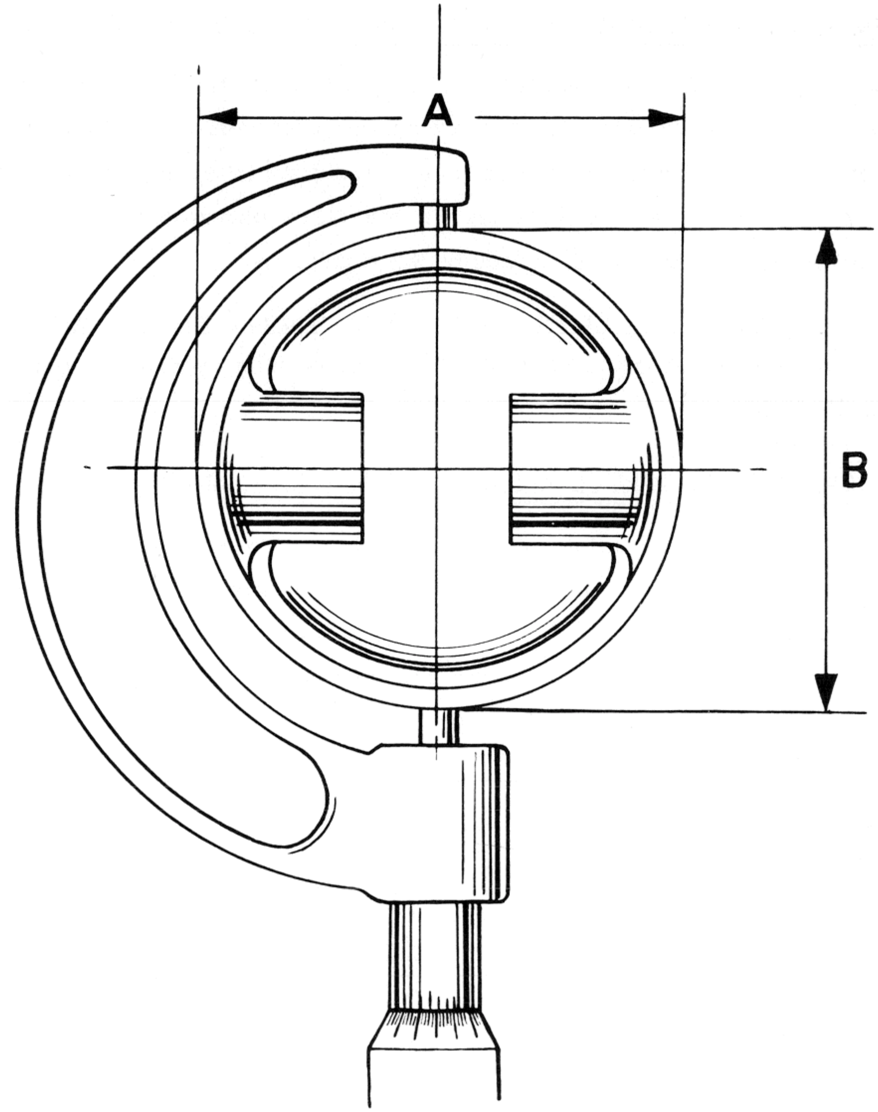
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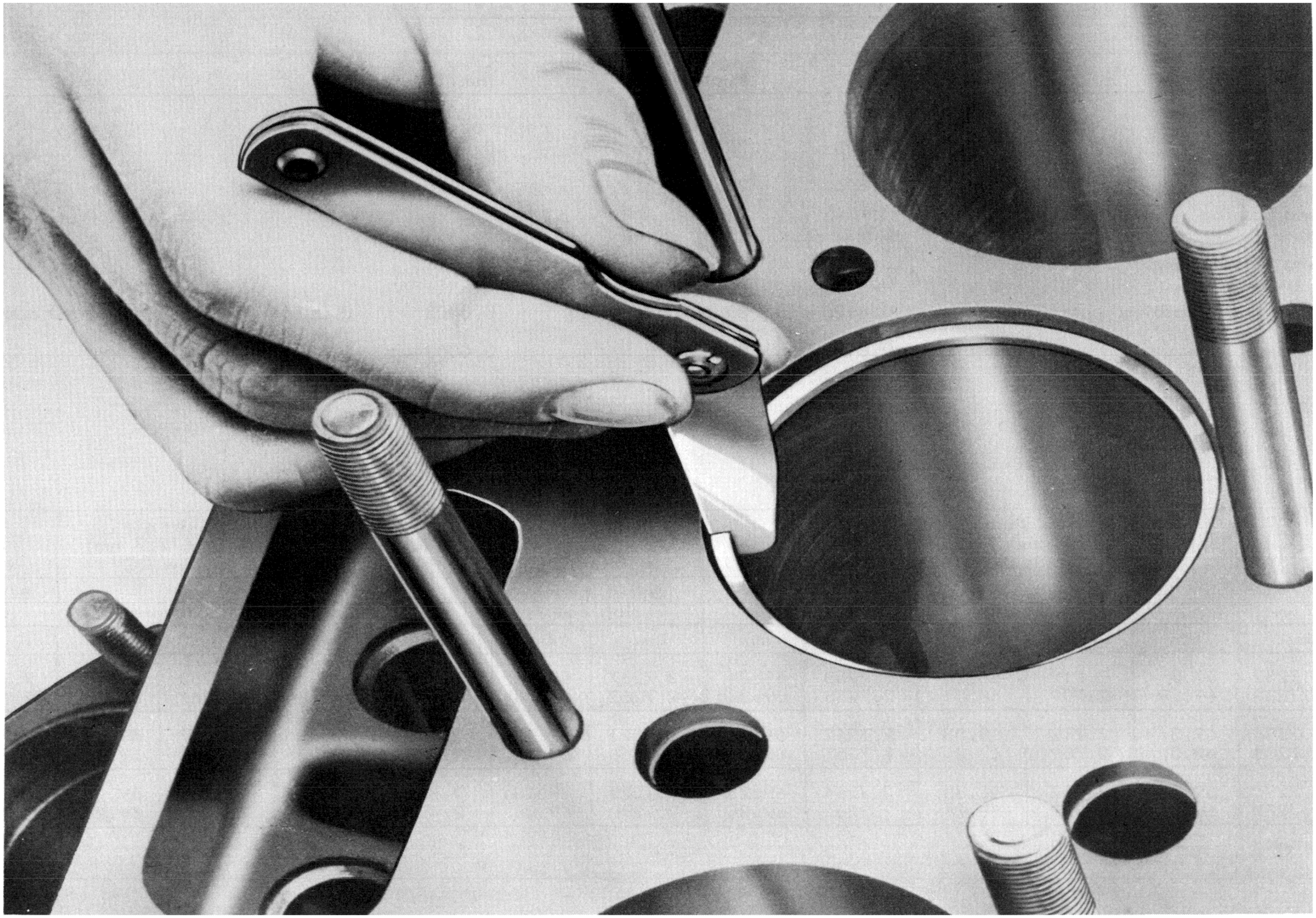
DIMENSIONS AND TOLERANCES

Parts and description	Dimensions new		Clearances new		Remarks
	ins.	mm	ins,	mm	
CONNECTING RODS					
Connecting rod width	0.898 0.896	22.81 22.76	0.0105 to 0.0126	0.0381 to 0.32004	
Bore for small end bushing	0.938 0.937	23.83 23.8			Press fit in rod.
Small end bushing external dia.	0.940 0.939	23.88 23.85			
Internal dia. of small end bushing	0.8126 0.8122	20.64 20.63	0.0003 to 0.00034	0.0076 to 0.00863	Light push fit in bushing.
Piston pin dia.	0.81250 0.81226	20.64 20.63			

PISTONS

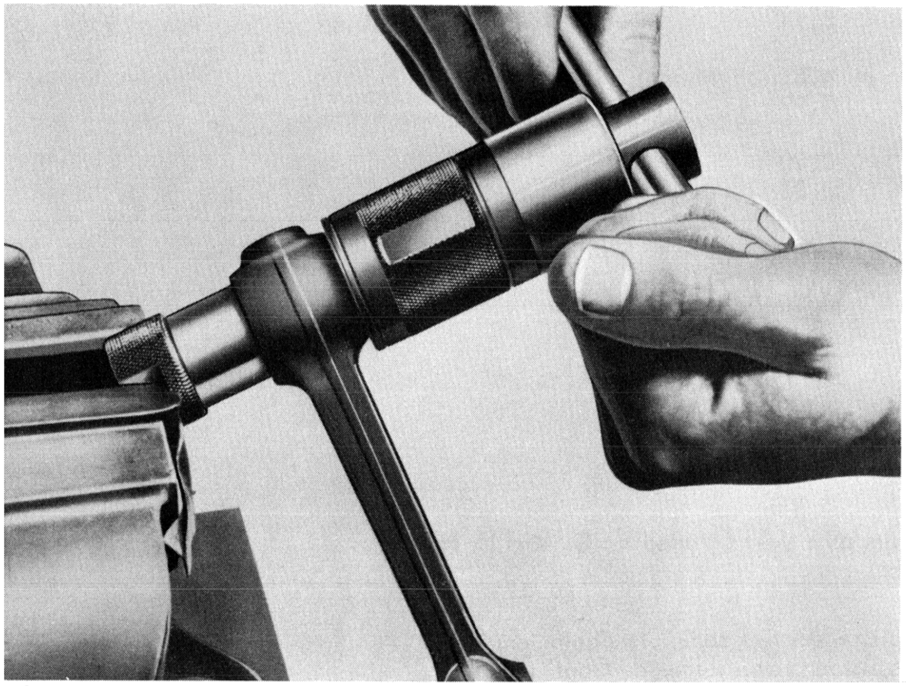
Grade	Bore		Top dia of piston ring "D"		Top dia of skirt "C"		Skirt dia 1/2" (12.7 mm) below "C"		Top dia of skirt "C"		Skirt dia 1/2" (12.7mm) below "C"		Bottom dia of skirt "B"	
			B.P.R. co. and Wellworthy		British piston ring co.		British piston ring co.		Wellworthy		Wellworthy		B.P.R. co. and Wellworthy	
	ins.	mm	ins.	mm	ins.	mm	ins.	mm	ins.	mm	ins.	mm	ins.	mm
F	2.7282 2.7279	69.3 69.29	22.712 2.709	68.88 68.81	2.7258 2.7253	69.24 69.23	2.7267 2.7262	69.26 69.24	2.7245 2.7242	69.2 69.19	2.7263 2.7267	69.25 69.24	2.7271 2.7268	69.27 69.26
G	2.7286 2.7283	69.31 69.3	2.712 2.709	68.88 68.81	2.7262 2.7257	69.25 69.24	2.7271 2.7266	69.27 69.25	2.7249 2.7246	69.21 69.20	2.7267 2.7264	69.26 69.25	2.7275 2.7272	69.28 69.27
H	2.7290 2.7287	69.32 69.31	2.712 2.709	68.88 68.81	2.7264 2.7261	69.26 69.25	2.7275 2.7270	69.28 69.26	2.7253 2.7250	69.27 69.26	2.7271 2.7268	69.27 69.26	2.7271 2.7268	69.29 69.28



PISTON RINGS	Dimensions new		Clearances new	
	ins.	mm	ins.	mm
Compression ring width	0.0787 0.0777	1.99 1.97	0.0015 to 0.0035	0.038 to 0.089
Groove width	0.0812 0.0802	2.06 2.03		
Oil control ring width	0.1563 0.1553	3.97 3.94	0.0007 to 0.0027	0.02 to 0.07
Oil control ring groove width	0.158 0.157	4.01 3.99		
Piston ring cap in cylinders	0.008 0.013	0.20 0.33		

PISTONS

Type	Aluminum split skirt (graded F. G. and H to suit bores)
Fitting	Slot in piston skirt to camshaft side of engine and / or piston grown stamped "front".
Number of rings	2 compression rings, 1 oil control ring.
Cap	0.008" to 0.013" (0.20 to 0.33 mm)
Maximum oversize for rebore	+ 0.030" (0.76 mm)
Oversize pistons available	+ 0.010" (.25 mm), + 0.020" (.51 mm) + 0.030" (.76 mm).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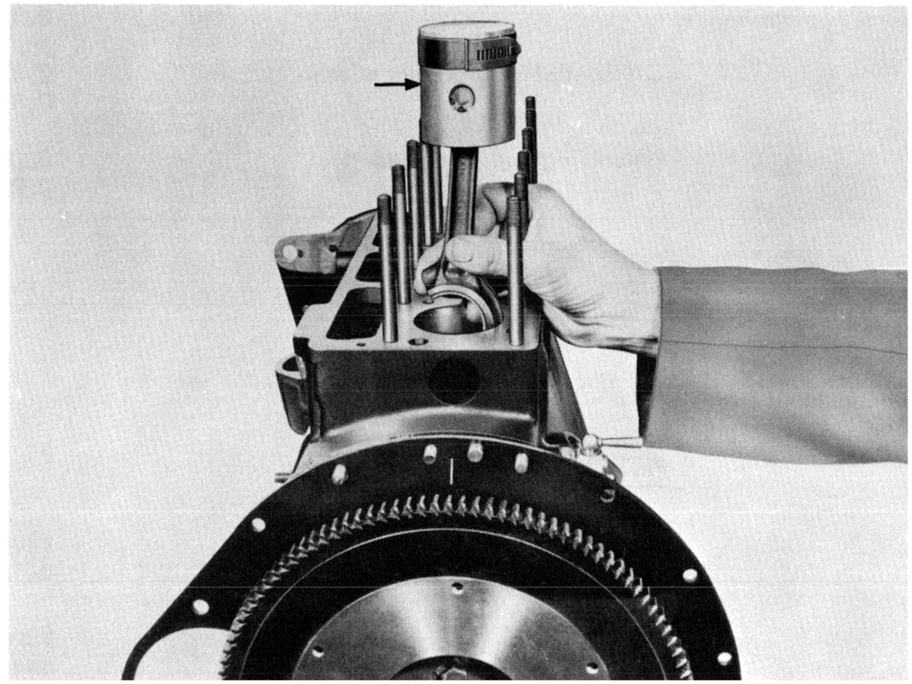
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If the leading edge of the ring gear teeth are only slightly damaged at the two points of starter engagement, i.e., the points at which the engine always stops, the flywheel may be turned through 90 degrees relative to the crankshaft, thus presenting new teeth to the starter pinion. This will necessitate re-marking of the T.D.C. position on the flywheel rim.

NOTE: When correctly positioned, the leading edges of the gear ring teeth should be facing the starter motor.

RE-MARKING FLYWHEEL

Mount a dial gauge indicator with its plunger on the piston crown and rotate the crankshaft until the piston moves to its highest point. Scribe a line across the flywheel to correspond with the line on the cylinder block.

This should be heavily marked with a small chisel, and numbers 1 and 4 punched each side of the line. The original T.D.C. mark must be obliterated with a ball peen hammer.

PISTONS, CONNECTING RODS AND PISTON PINS

During manufacture of the cylinder blocks the bores are graded "F", "G" or "H" according to their limits. These letters are stamped on the drain tap side of the block adjacent to each bore. The bore sizes corresponding to these symbols are given on page 39. Pistons are also supplied in similar grades, the appropriate letter being stamped on the crown of the pistons.

When new pistons are fitted, it is advisable that they should bear the same identification symbols as the cylinder bores.

Before fitting pistons to the connecting rods, check the piston pin and small end bushes for wear. If new bushes are required, the old ones can

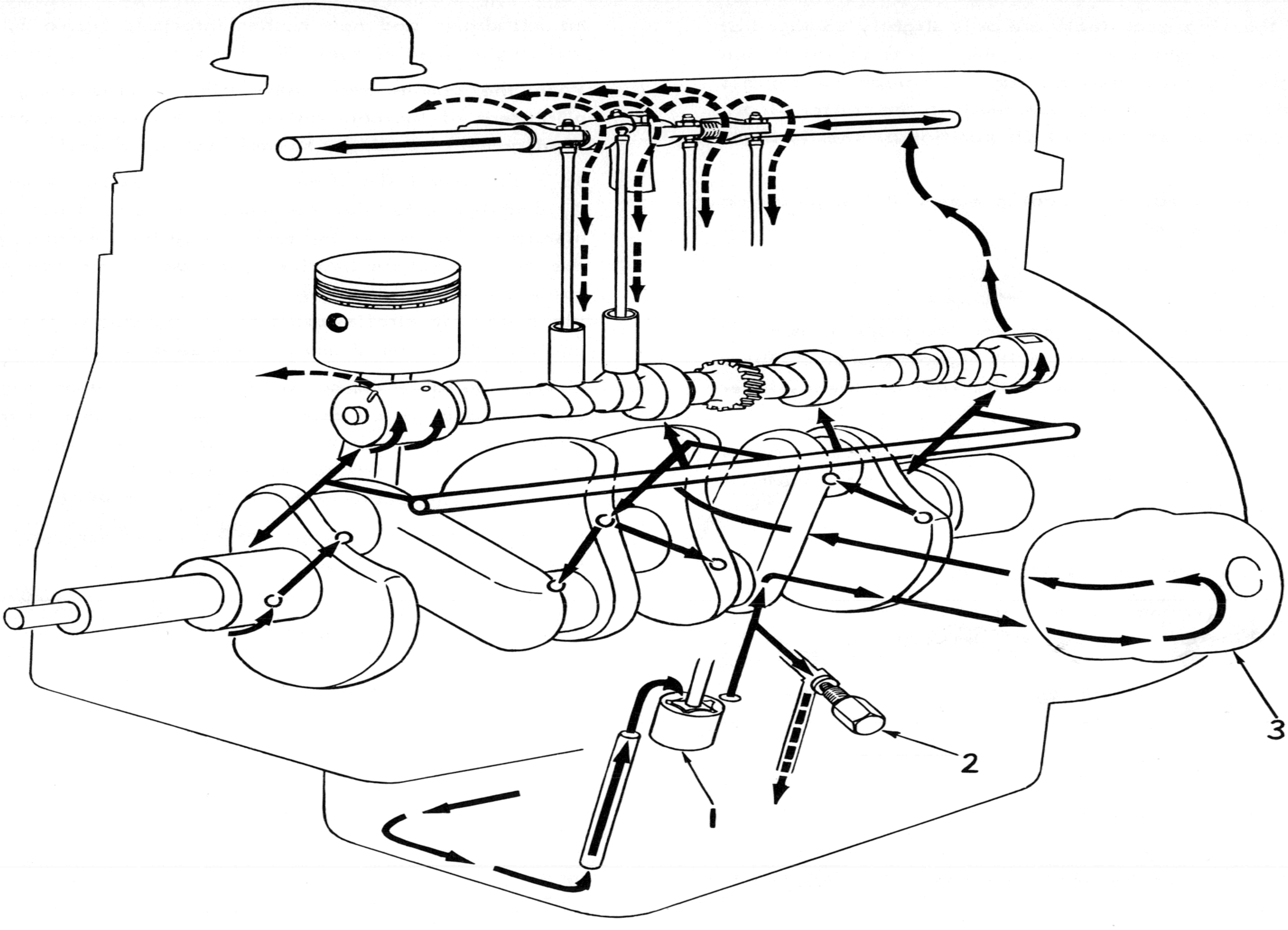
be withdrawn and new bushes inserted, figure 1, in one operation by utilizing a special tool. The bushes must then be reamed to suit the pins.

With the bushes and piston pins in satisfactory condition, check the alignment of the connecting rods. If necessary, correct any inaccuracies of alignment by using a suitable setting wrench.

To avoid piston distortion and also to facilitate easy fitting of the piston, it is advisable to heat the pistons in a can of hot water. When fitting the pistons to the connecting rods it must be remembered that the split side of the piston and the bearing cap side of the con-rod must both be at the camshaft side of the engine as shown on fig. 2. It is also important that the piston pin circlips are properly located in the piston pin bore grooves and that the con-rod small end is centrally disposed in the piston.

Using a suitable clamp to compress the piston rings, figure 2, lower the con-rod and piston assembly down the bore with the split side of the piston on the camshaft side of the engine until the big ends engage the crankpins. After fitting the caps and tightening the big end cap bolts to correct torque secure these by turning up the lockplate tabs.

NOTE: The big end caps are not interchangeable and must not be filed to take up bearing wear.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LUBRICATION

A pressed steel oil sump of 4 qts. (4,5 liters) capacity is bolted to the bottom face of the cylinder block. Oil is drawn from the sump by a Hobourne-Eaton double rotor type oil pump which passes the oil under pressure to an annular space around the vertical pump drive shaft.

From this space, oil is forced through a passage cast in the cylinder block to the input side of a full-flow filter. The oil passes through the filter, which incorporates a non-return valve and a by-pass valve, returning through the central threaded filter boss to the oil gallery, which runs the whole length of the cylinder block.

The oil passes from the oil gallery through various drilled passage-ways to the main bearing, camshaft and cylinder head. Oil fed to the main bearings is then conveyed through drillings in the crankshaft webs to the big end bearings. Surplus oil forced out of these bearings serves to lubricate the cylinder walls, pistons and piston pins.

Each camshaft journal is provided with a scroll which serves to distribute oil across its width. The rear journal is also provided with two flats. A vertical drilling in the rear of the block carries oil from the rear camshaft bearing, metered by the two flats on the journal, up through a hole in the cylinder head and via a matched hole in the rear pedestal into the hollow rocker shaft.

The oil then passes along the rocker shaft to lubricate each rocker before being ultimately splashed on to the valve guides, push rods and tappets. The timing chain and tensioner are lubricated by oil escaping from the front camshaft bearing, the oil being thrown outwards by the timing sprocket before finally returning to the sump.

PRESSURE RELEASE

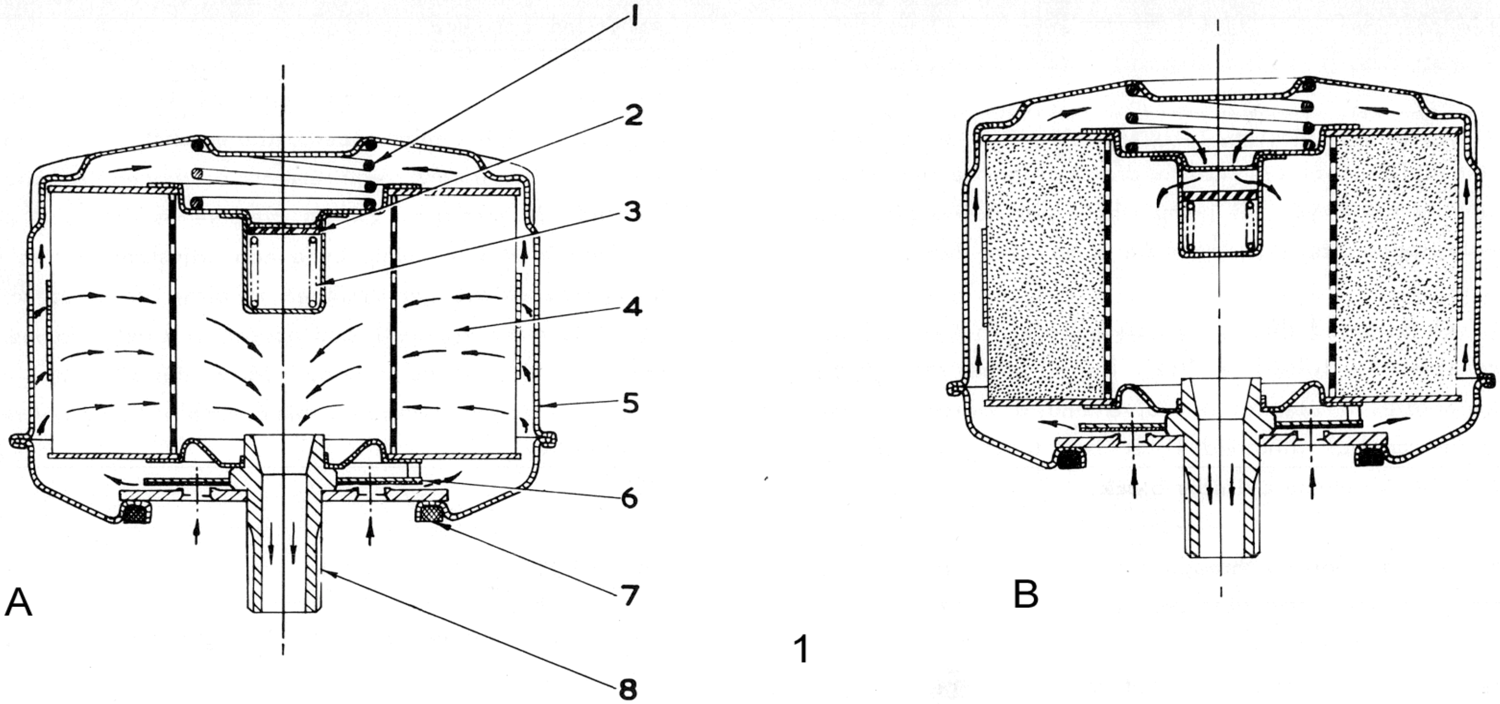
The delivery of oil from the pump will increase as the engine is speeded up and at high engine speeds, the quantity of oil available is greatly in excess of the normal requirements of the engine and will result in increased oil pressure. Excess pressure is released and the surplus oil returned to the oil sump by a non-adjustable valve which consists of a spring-loaded plunger designed to blow off at 65 to 70 lbs. per sq. in. (4.57 to 4.92 kg/cm^2) and housed in a large domed bolt, screwed into the L. H. side of the crankcase above the oil pump. Apart from cleaning during an engine overhaul, this assembly should not require maintenance or attention.

OIL PRESSURE INDICATION

Pressure is indicated by a warning light mounted in the speedometer dial and controlled by a hydraulic switch which is screwed into a tapped hole in the centre of the oil gallery. The switch contacts are designed to open, and thus cut-off the electrical supply to the warning light when the oil pressure reaches 5 to 7 lbs. per sq. in. (0.35 to 0.49 kg/cm^2). The contacts remaining open at all pressures above this figure. The switch is non-adjustable and does not require maintenance.

OIL FILTRATION

The engine is fitted with a full flow oil filter which may be of Purolator, A.C. or Tecalemit manufacture. The filter element is housed in a pressed steel container which screws onto a machined face on the L.H. side of the cylinder block. A synthetic rubber seal secured between a flange on the filter container and its mounting face on the cylinder block prevents oil leakage.



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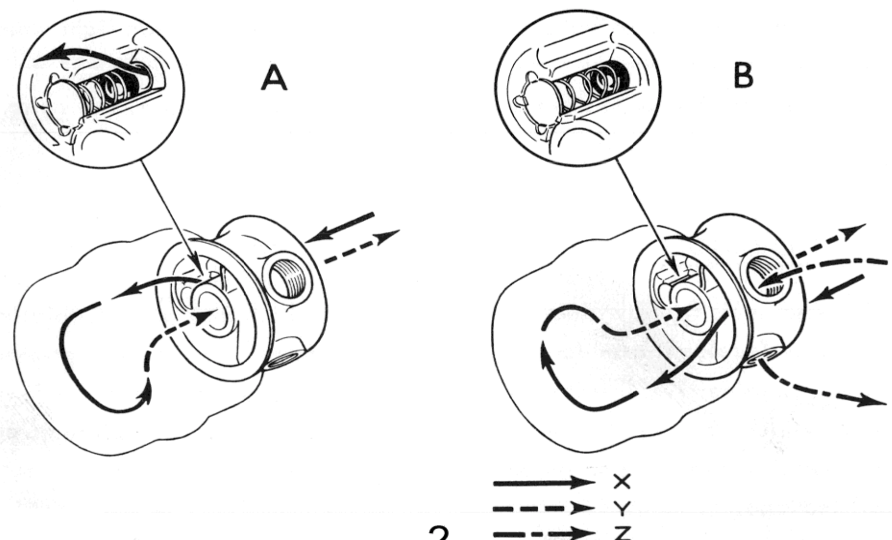

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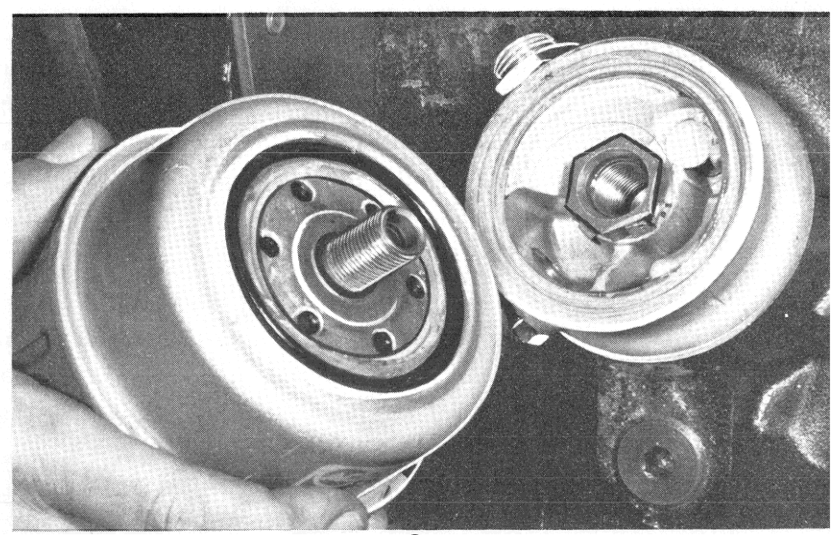

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Oil under pressure enters the filter container through holes in its base and lifts the spring-loaded non-return valve disc (6) off its seating. Oil is then forced around the outside of the filter element and passes through the element to the centre. The filtered oil then passes through the hollow central threaded filter boss to the oil gallery as shown on figure 1 at "A".

If the filter element becomes blocked, the by-pass valve (2) opens at a predetermined differential pressure between the input and output sides of the filter, permitting the oil to by-pass the filter element as shown on figure 1 (B).

RENEWING THE OIL FILTER. FIGURE 3

1. After removing the old filter, clean all traces of adhesive from the adaptor surface.
2. Smear sufficient grease in groove of filter, and always fit a new sealing ring and smear with grease.
3. Screw in filter as tight as possible using both hands, filter body and hands to be dry and clean to achieve max. tightening torque (this should be equivalent to 15.18 lbs ft. torque).
4. Check that there is metal to metal contact between ridge on filter body and adaptor face all round. It is essential that this condition is achieved, if there are any gaps reject filter and fit another.
5. Run engine at varying speeds for five minutes to ensure repeated operation of pump relief valve to fully pressurize filter.
6. Retighten filter to 15.18 lbs.ft. torque or equivalent by hand. Check for oil leaks.
7. Finally, check oil level in sump and top up if necessary.

OIL COOLER ADAPTOR

DESCRIPTION

The oil cooler adaptor fits between the cylinder block and the oil filter. In addition to forming a connection point from the engine to the oil cooler, the adaptor also provides a degree of thermostatic control over operation of the oil cooler.

The oil cooler adaptor is secured to the cylinder block by a central hollow bolt.

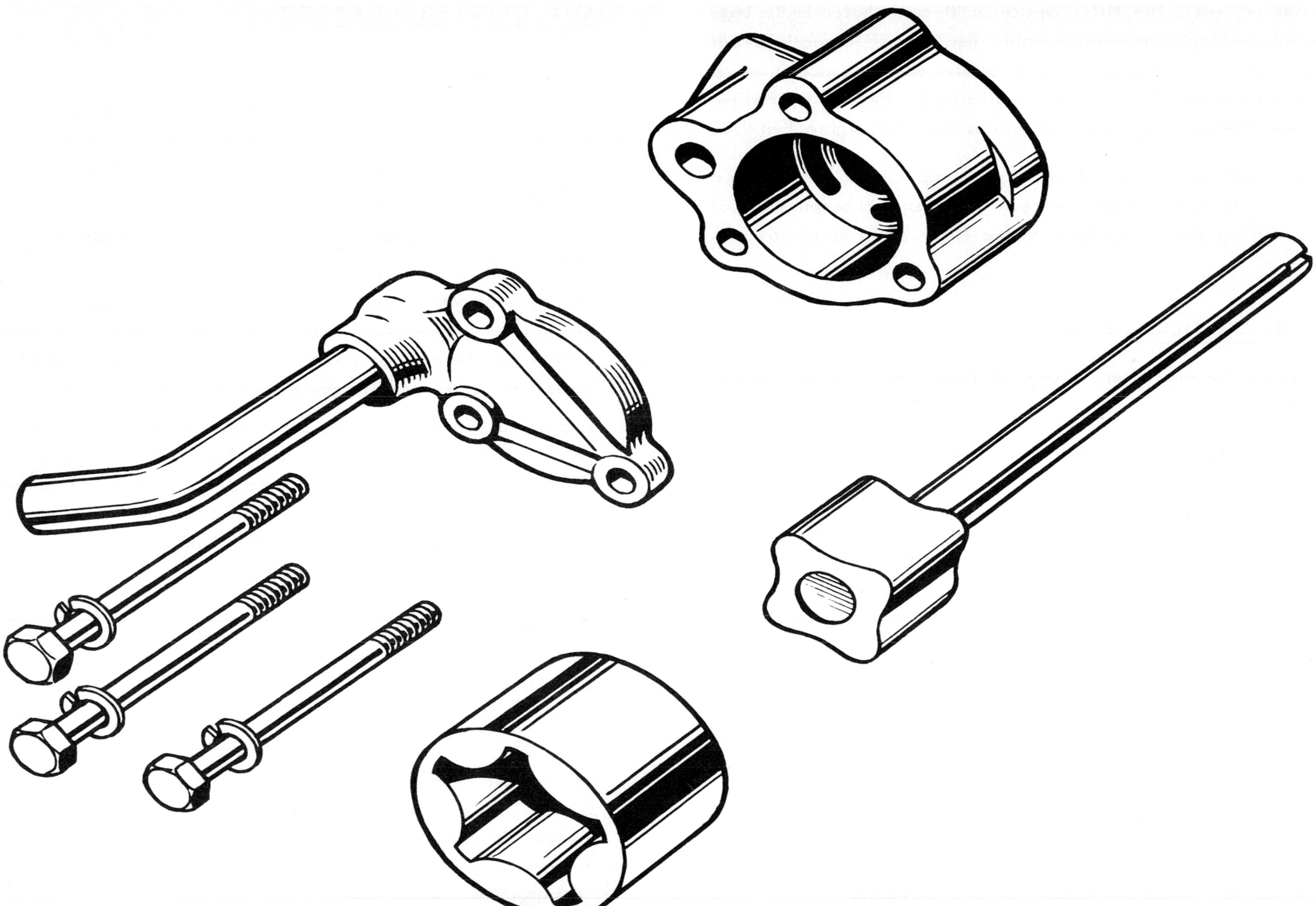
The adaptor lower face is sealed to the mounting face on the cylinder block with a synthetic rubber ring. The hollow attachment bolt of the normal full flow filter screws into the cooler adaptor attachment bolt, whilst the outer edge of the filter body seals on the face of the adaptor.

A chamber on the cylinder block side of the adaptor communicates with an outlet union boss. A pipe from this boss connects the adaptor to the cooler. A return pipe from the cooler connects to a chamber formed in the filter side of the adaptor. The inner chamber also communicates with the outer one through a spring-loaded ball valve.

OPERATION. FIGURE 2

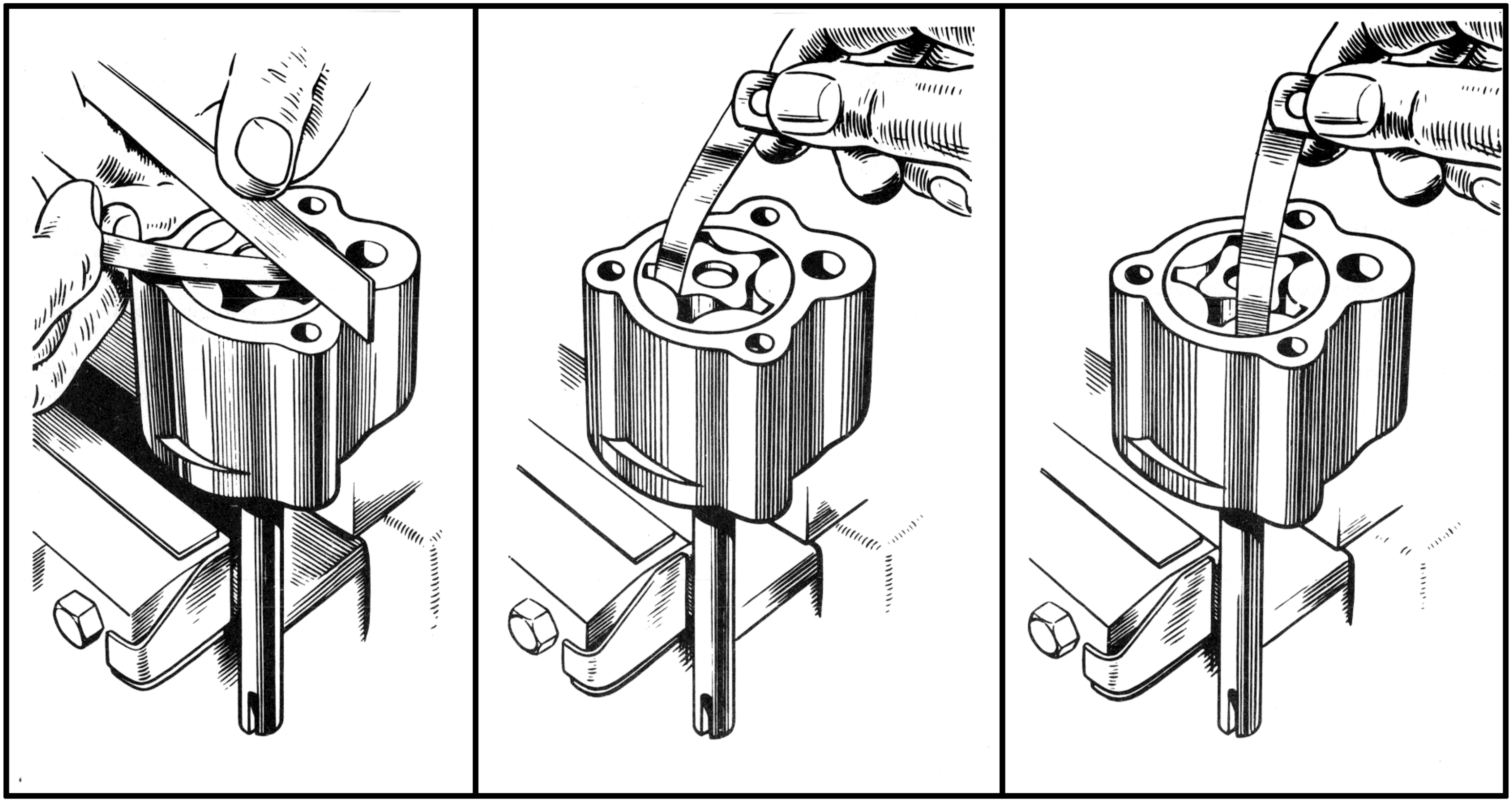
Oil passes from the passage in the cylinder block, into the filter adaptor. When the oil is cold, the viscosity and pressure is sufficient to lift the ball off its seat, permitting the bulk of the oil to flow directly through the filter and returning to the oil gallery through the central drilling as shown at "A".

As the oil temperature increases, the viscosity, and therefore, the pressure, decreases until a point is reached when the oil pressure will no longer lift the ball off its seat. Under this condition, oil is pumped into the inner adaptor chamber and through the oil cooler before returning to the outer adaptor chamber.



DIMENSIONS AND TOLERANCES

Parts and description	Dimensions new		Clearances new		Remarks
	ins.	mm	ins,	mm	
OIL PUMP					
Depth of rotor	0.9995 0.9985	25.37 25.36	0.0006 to 0.0017	0.01524 to 0.043	A combined worn clearance of 0.004" (1.1016 mm) indicates necessity for lapping of the cover and housing face.
Housing depth	1.002 1.001	25.45 25.43			
Max. permissible clearance between outer and inner and body			0.008	0.2032	Renew outer rotor and/or housing if worn beyond this limit.
Max. permissible clearance between outer and inner rotors			0.010	0.254	Renew inner and outer rotors if worn beyond this limit.
Distributor drive gear end Float			0.003 0.007	.08 .18	Adjust by fitting paper shims beneath distributor pedestal.
Distributor drive gear spindle dia.	0.499 0.498	12.67 12.65	0.0005 to 0.003	0.0127 to 0.0762	
Distributor drive gear bush Bore	0.5005 0.501	12.71 12.73			
OIL PRESSURE RELIEF VALVE					
Free length	1.53	38.86			
Fitted length	1.25	31.75			
Load at fitted length	14.5 lb.	6.58 kg			
Rate	56 lb/in.				
ROCKER SHAFT					
Diameter	0.5612 0.5607	14.26 14.24	0.0023 to 0.0008	0.06 to 0.02	



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From this chamber it passes through the filter before returning to the ail gallery through the central drilling, as shown at "B".

Should the oil cooler become blocked with foreign matter, oil pressure will lift the ball valve from its seating and permit oil circulation directly through the filter.

OIL PUMP

To check the rotors for excessive wear, fit the rotors to the pump body and measure the clearance between the lobes of the inner and outer rotors as shown on figure 2 (centre). This should be less than 0.010" (0.254 mm) .

Determine the clearance between the outer rotor and body by inserting a feeler gauge as shown on figure 3 (right). This should be less than 0.008"

(0.2032 mm). With the rotors in position, place a straight edge across the pump body as shown on figure 1 (left). Check the clearance with feeler gauges between the straight edge and the ends of the rotors. This should be less than 0.004" (0.102 mm).

Renew the oil pump components as necessary if the clearances exceed those quoted.

Fit the inner rotor to the oil pump housing, followed by the outer rotor with its chamfered face leading. Seat the assembly in the crankcase with the intake pipe facing rearwards and tighten the three long bolts with spring washers to a torque of 6 to 8 lbs/ft.

There is no paper joint between either the pump housing and block or the housing and end cover.

GENERAL DATA

VALVE TIMING

Inlet valve opens	12º B.T.D.C.
Inlet valve closes	52º A.B.D.C.
Exhaust valve opens	52º B.B.D.C.
Exhaust valve closes	12º A.T.D.C.

VALVE TIME MARKINGS

Scribed lines on crankshaft camshaft sprockets correspond with no. 1 cylinder at top of compression stroke. Centre punch mark on camshaft sprocket corresponds with cut away on camshaft boss.

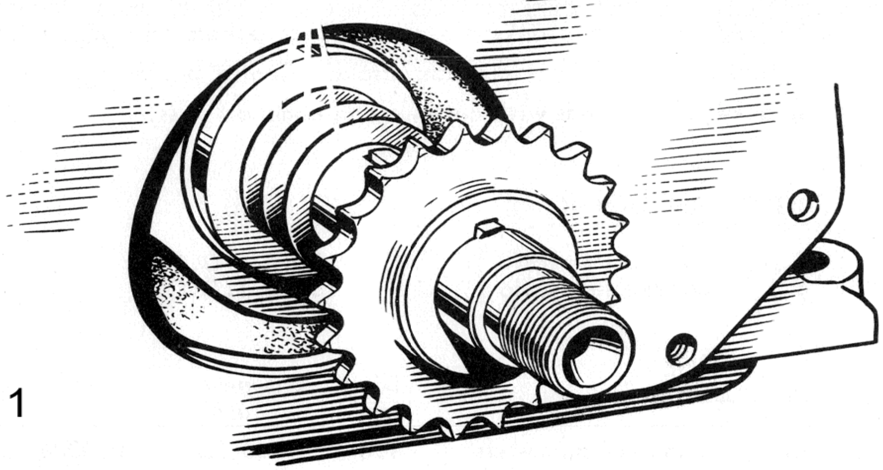
IGNITION TIMING

6.8 : 1	compression ratio	9º B.T.D.C.
8 : 1	compression ratio	15º B.T.D.C.

CAMSHAFT	Dimensions new		Clearances new	
	ins.	mm	ins.	mm
Camshaft journal diameters	1.8407 1.8402	46.75 46.74	0.0026 to 0.0046	0.07 to 0.12
Bore in block	1.8433 1.8448	46.82 46.86		
End float	0.008 0.004	0.20 0.10		
Tappet dia.	0.6871 0.6867	17.45 17.44	0.0002 to 0.0013	0.00508 to 0.03302
Tappet bore in cylinder block	0.688 0.6873	17.47 17.46		

TIMING CHAIN

Roller dia.	0.250	6.35		
Number of pitches	62			
Timing chain pitch	0.375	9.525		
Oil pump (outer rotor) outside dia.	1.598 1.597	40.59 40.56	0.005 to 0.007	0.127 to 0.178
Housing internal dia.	1.603 1.604	40.72 40.74		



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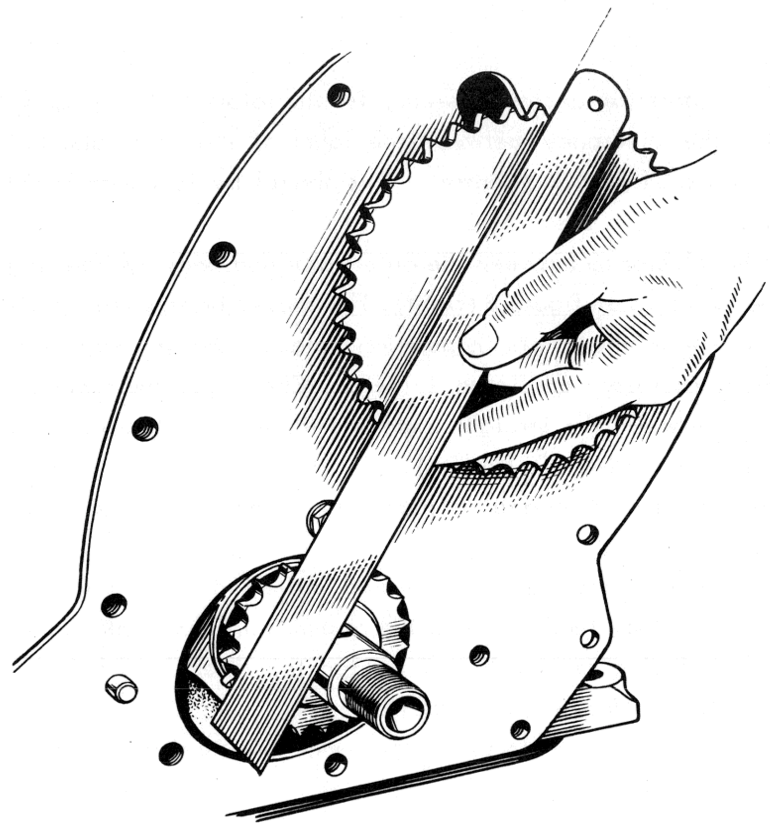

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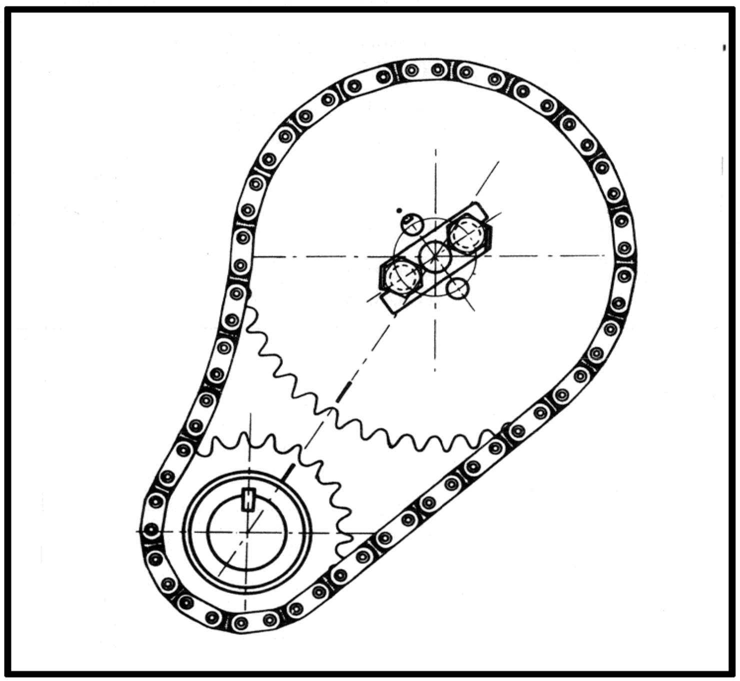

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OIL SUMP AND BREATHER PIPE

Fit the breather pipe to the crankcase and using a new gasket, attach the oil sump, the longer setscrew being used for the breather pipe clip attachment.

Secure the manifold drain pipe clip to the appropriate sump setscrew.

CAMSHAFT AND TAPPETS

Lubricate the camshaft bearings and fit the camshaft. Secure this by attaching the camshaft retainer. After cleaning and oiling each tappet, insert these into the cylinder block.

PUSH RODS, CYLINDER HEAD AND ROCKER SHAFT ASSEMBLY

Fit the above items as described on page 25.

VALVE TIMING AND SPROCKETS

Fit the original shim pack to the front of the crankshaft and position the woodruff key, press the crankshaft timing sprocket with its internally chamfered end leading, over the woodruff key, until the shims are fully compressed (figure 1).

Using two setscrews, temporarily attach the camshaft sprocket to the camshaft and check the alignment of both sprockets with a straight edge (figure 2) .Where misalignment is evident, correct this by increasing or decreasing the shim pack thickness as necessary, then remove the camshaft sprocket.

UTILISING TIMING MARKS TO RE-SET TIMING

If the original sprockets are being refitted, it should be noted that the front face of the sprocket is marked with a centre punch, near one of the attachment holes. The camshaft itself is provided with a cut-away which should be aligned as shown on figure 3. Both sprockets are also marked with scribed lines.

Utilizing these marks for re-setting the valve timing, the procedure is as follows:

a. Rotate the crankshaft until numbers one and four pistons are at T.D.C. An arrow on the flywheel will then be aligned with a similar mark on the cylinder block and the sprocket's driving key will be pointing upwards.

   A mark scribed on the front face of the crankshaft sprocket will also be pointing towards the centre of the camshaft.

b. Placing the markings as shown on figure 3, temporarily attach the camshaft sprocket to the camshaft and rotate this in order to align its scribed line with a similar one on the face of the crankshaft sprocket.

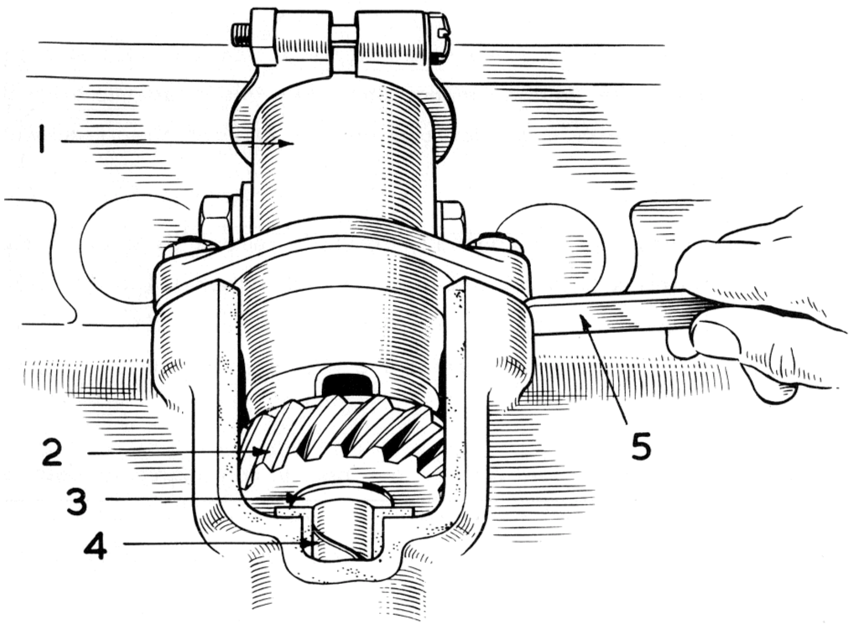
c. Without disturbing the camshaft, carefully remove its sprocket and, after encircling both this and the crankshaft sprocket with the chain, refit the camshaft sprocket in exactly the same position as before, and finally secure by tightening the two setscrews and turning the lockplate tabs.

This completes the valve timing, but before continuing to describe further assembly the following instructions are included for dealing with new and unmarked components or where the accuracy of existing marks is in doubt.

SETTING VALVE TIMING WITH UNMARKED GEARS

This necessitates the use of special rocker clearances as follows:

a. Temporarily attach the camshaft sprocket and, numbering from the front, turn the camshaft until number one push rod has reached its highest point.



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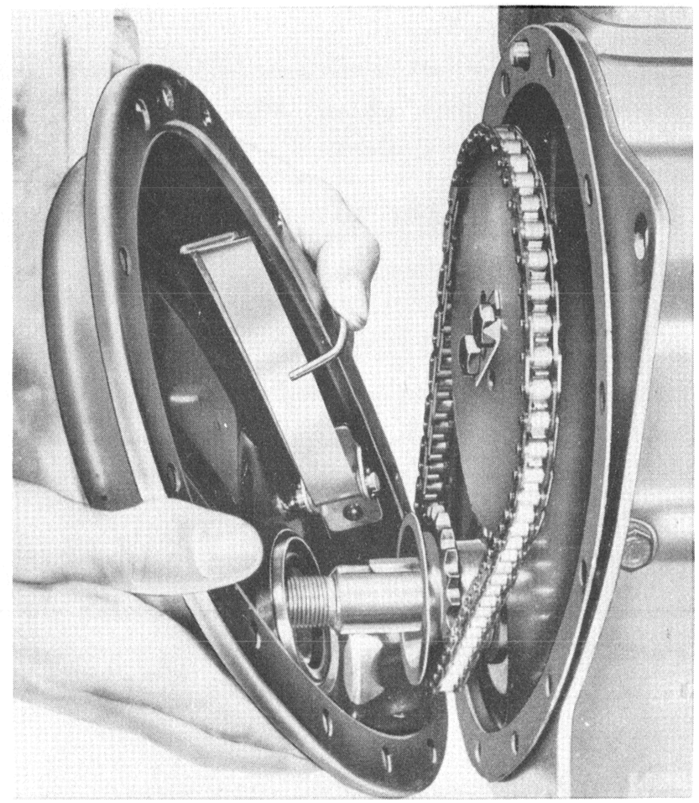

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In this position, adjust number eight rocker clearance to 0.040" (1.016 mm).

b. Repeat the procedure with number two pushrod and adjust number seven rocker until its clearance is identical to that of number eight rocker.

c. Again rotate the camshaft until numbers seven and eight valves have reached the point of balance, that is where one valve has just closed and the other is about to open. With careful movement, adjust the camshaft until the largest feeler possible is equally nipped by both numbers seven and eight rockers.

d. Without disturbing the position of the camshaft, carefully remove the timing sprocket and set numbers one and four pistons at T.D.C.

Four holes are provided in the camshaft timing sprocket which are equally spaced but offset from a tooth centre. When the sprocket is fitted at 90 degrees to its initial position, which location is identified as position "A", a half tooth of adjustment is obtained.

If the sprocket is turned "back to front" from position "A", a quarter of a tooth adjustment is obtained, whilst a 90-degree movement in this reversed position will give three quarters of a tooth variation from that given by position "A". It will be appreciated, therefore, that with careful manipulation of the camshaft sprocket, extremely fine adjustment can be obtained.

e. Encircle the two sprockets with the timing chain and offer up the camshaft sprocket. If the holes are not in alignment with those of the camshaft, release the sprocket and work it around the inside of the chain, one link at a time repeatedly offering up the sprocket and examining the attachment holes for alignment whilst pressure is exerted on the top side of the chain.

f. When alignment is satisfactory, secure the sprocket by tightening the attachment bolts and turning up the lockplates. To ensure that no errors have been made, re-check the timing. This involves turning the flywheel a few teeth backwards, then slowly forward in normal direction of rotation until numbers seven and eight rocker clearances become equal. This position should coincide exactly with numbers one and four pistons at T.D.C.

Suitably mark the sprockets and finally re-set all rockers to the correct clearance of 0.010" (0.254 mm).

TIMING COVER AND CRANKSHAFT PULLEY, FIGURE 2.

Fit the oil thrower (63) with its dished face towards the timing cover. Grease the timing cover gasket (123) and place it over the two dowels. Having fitted a new oil seal (121) in the timing cover and, if necessary, a new chain tensioner (1) compress this with a suitable tool and locate the cover on the two dowels. Secure by fitting and tightening the various attachment setscrews.

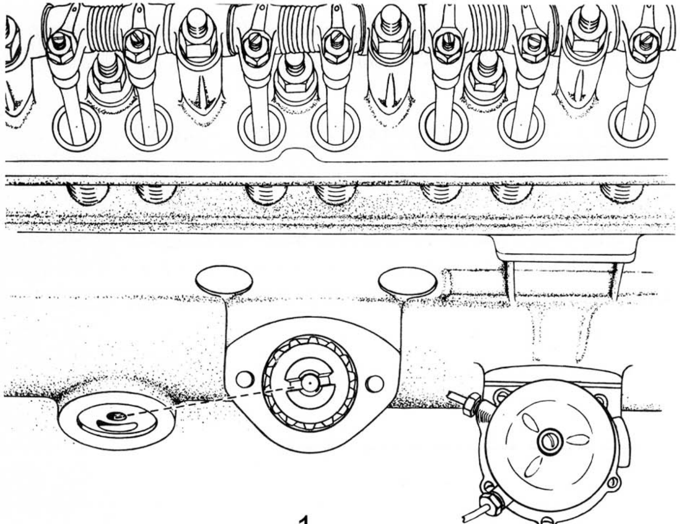
Fit the crankshaft pulley (64) followed by the retaining nut (65).

DISTRIBUTOR AND IGNITION TIMING

Distributor drive gear end float (figure 1).

a. Place a washer (3) having an internal diameter of 1/2" (12.7 mm) and a thickness of 0.030" (0.76 mm) over the oil pump drive spindle (4), then enter the gear and spindle assembly into its bushing in the cylinder block, taking care to engage the oil pump driving spindle tongue with the corresponding slot in the oil pump spindle.

b. Fit the distributor pedestal (1) and evenly tighten the securing nuts until the end float of the distributor drive gear is just eliminated.



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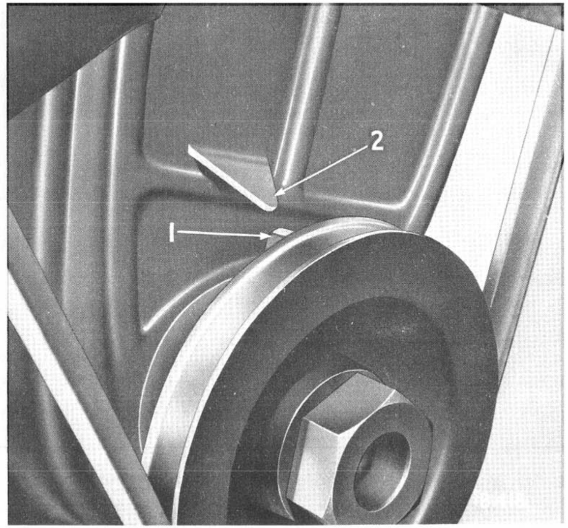

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c. Using feeler gauges, measure the clearance between the distributor pedestal and the cylinder block faces.

d. The thickness of paper shims required to give the specified distributor drive gear end float of 0.003" to 0.007" (0.08 mm to 0.18 mm) is determined as follows:

   Subtract the clearance between the pedestal and cylinder block faces from the thickness of the washer (3).

   The resultant dimension, plus the specified end float, is the thickness of the shim pack required.

e. Remove the distributor pedestal, gear, spindle assembly and washer (3). The washer must not be re-fitted.

   With no. 1 piston at T.D.C. on the compression stroke, re-enter the spindle and gear in such a position that when the gear is fully home the driving slot assumes a position as shown on figure 1 with the slot offset nearest to the cylinder block.

f. Place the paper shim pack (see paragraph d) over the pedestal studs, followed by the pedestal (1) and secure with nuts and spring washer.

DISTRIBUTOR	Lucas type D.M. 2.
6.8 : 1 compression ratio	Lucas no. 40755. Advance curve ECM 737
8 : 1 compression ratio	Lucas no. 40743 A. Advance curve ECM 734
Contact breaker gap	0.015" (0.4 mm)

DISTRIBUTOR TIMING

Enter the distributor into the pedestal, engaging the driving tongue with its corresponding slot in the gear boss.

With the contact breaker gap set at 0.015" (0.4 mm) adjust the position of the distributor so that the points commence to open at the specified setting, depending on compression ratio, see page 2. If correctly timed, the rotor arm will face no. 1 segment in the distributor cap. Clamp the distributor in position by tightening the nut on the pedestal pinch bolt.

It may be necessary to modify this setting during road test to obtain the best performance.

ROCKER COVER, MANIFOLD, OIL PRESSURE RELEASE VALVE AND OIL FILTER

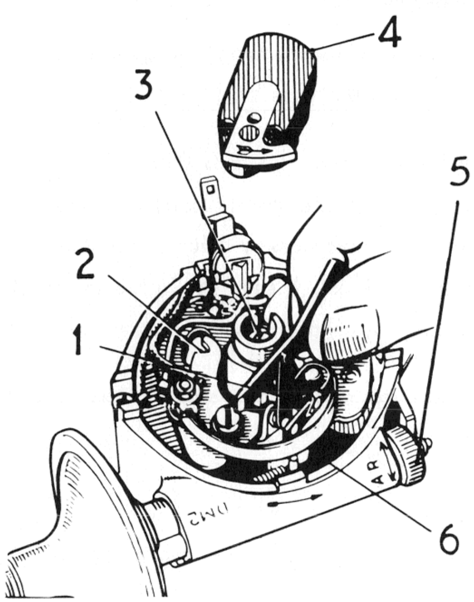
Coat one side of a new cork rocker cover gasket with jointing compound, and when tacky, attach the gasket to the flange face of the cover. Place the rocker cover, face downwards, on a flat surface, and place a weight on the top of the cover, leaving until set.

Position the cover over the two studs on the cylinder head, and secure with fibre washers, plain washers and nyloc nuts.

Fit and secure the inlet and exhaust manifold (5) with the gasket (18) steel face outwards.

Fit the oil filter, tightening it sufficiently to form an oil-tight joint.

Fit the oil pressure release valve (100) spring (101), domed cap (103) and copper washer (102) to the cylinder block.



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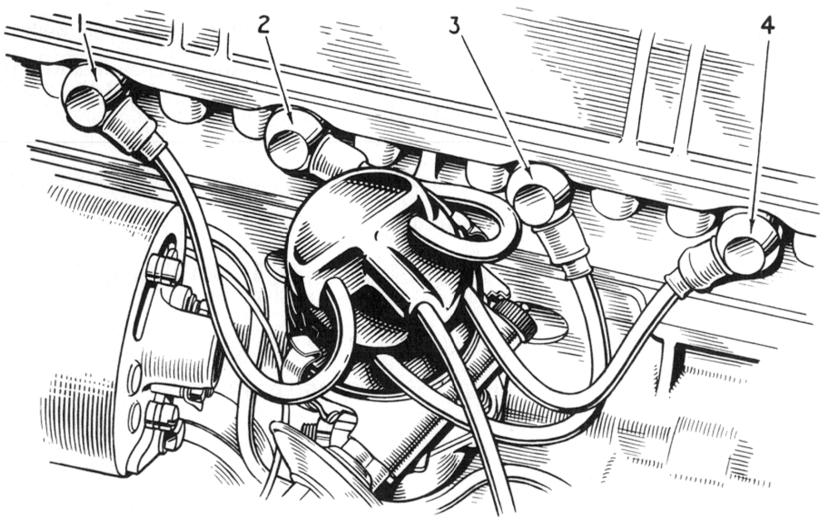

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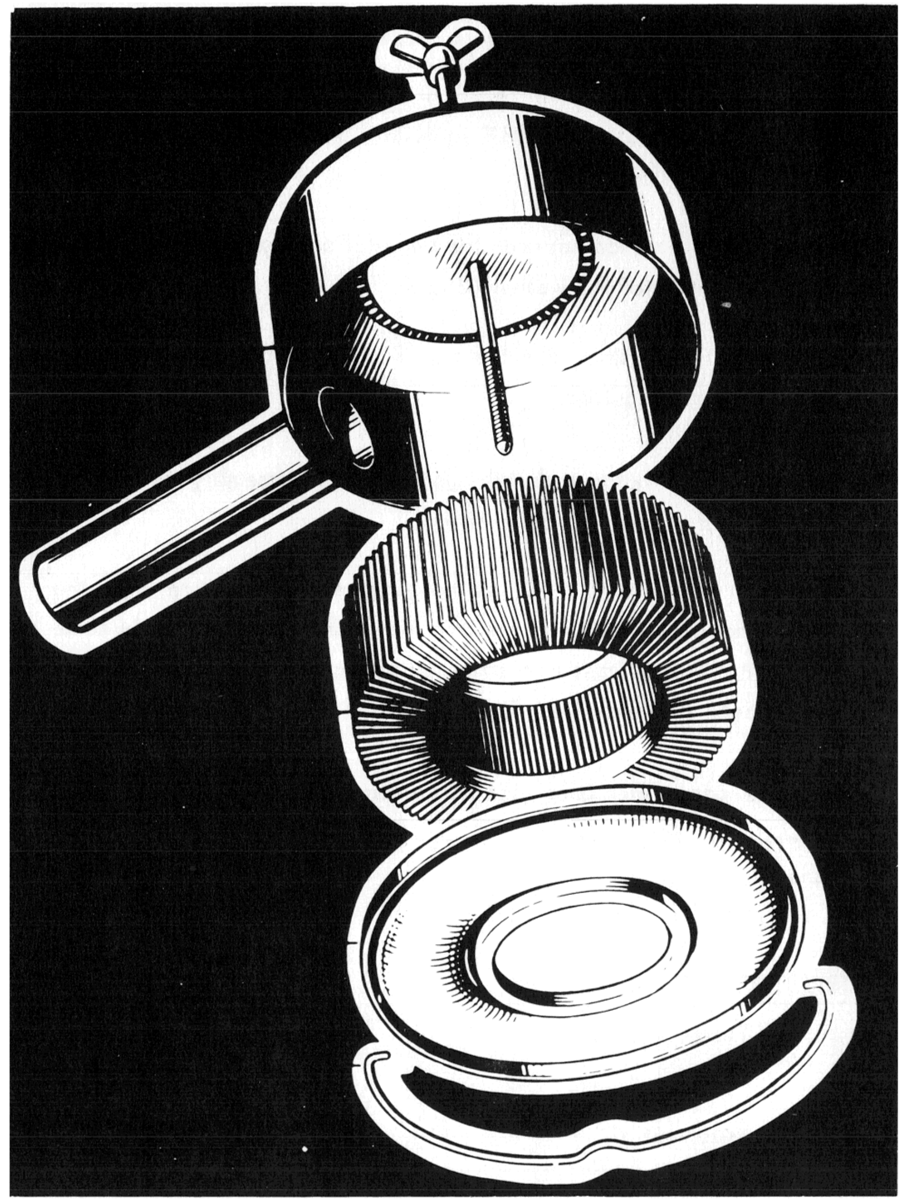

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WATER PUMP AND GENERATOR

Position the water pump gasket on the block with grease and fit the water pump to the cylinder head. The longest of the three attachment bolts is fitted to the upper left-hand hole viewed from the front of the engine. The upper right-hand bolt carries the generator adjusting strap. Fit the thermostat with its packing washer and the water outlet body. The fuel pipe and suction advance pipe clip is fixed to the right-hand bolt.

Attach the generator bracket to the crankcase and the generator pedestal to the front engine bearer plate. Mount the generator in position, fit and adjust the fan-belt to give 1" (25.4 mm) slack on its longest run and finally secure all generator attachment bolts.

CARBURETTOR, FUEL PUMP AND PIPES

Position an asbestos insulating gasket over the carburettor mounting studs on the manifold. Attach the carburettor and secure this with spring washers and nuts. Connect up the choke and throttle cables.

Fit the fuel pump and the original thickness of packing washers to the cylinder block, ensuring that the operating lever engages correctly with the eccentric on the camshaft. Secure with nuts and spring washers.

Note that the extension nut with screwdriver slot fits on the rear stud.

Utilizing a clip, attach the fuel and vacuum advance pipes to the water elbow attachment bolt.

Fit the breather pipe by driving its upper end into the hole on the R.H. side of the cylinder block and secure the lower end with the combined clip and baffle plate, attaching the clip to one of the sump bolts.

FIRING ORDER

1, 3, 4, 2.

SPARKING PLUGS, H.T. LEADS, AIR CLEANERS ETC.

After setting the gaps at 0.025" (0.65 mm), figure 1, or 0.030" (0.762 mm) on 7 : 1 compression ratio engines, fit the sparking plugs. Fit the distributor cover and attach the H.T. leads in the firing order 1, 3, 4, 2, as shown on figure 2. Attach the air cleaner.

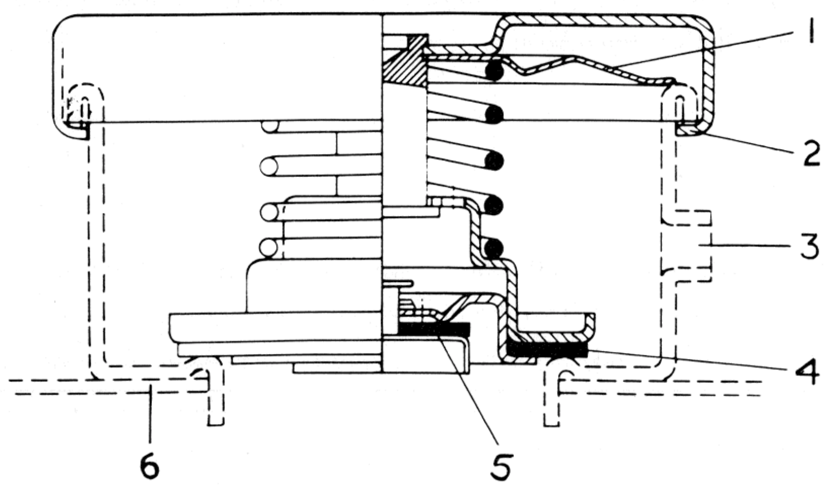
Fit the cylinder block drain plug, the dipstick and the oil pressure warning light switch, which screws into the tapped hole in the oil gallery. Check that the manifold drain pipe is free from obstruction and fit this into position with its lower end carried by the small clip attached to one of the oil sump bolts.

AIR CLEANER, FIGURE 3

Every 3.000 miles (5.000 km), unscrew the retaining screw (11) and detach the cover (9) from the air cleaner. Remove the paper element (8) from the casing and, with a low pressure compressed airline or a soft brush, clean between the folds of the paper. Clean the interior of the casing and re-fit the element (8) and cover (9), securing this by tightening the screw (11) .

Every 12.000 miles (20.000 km) renew the paper element. Under dusty conditions clean or renew the element more frequently.

To remove the complete air cleaner, slacken the clip (5) and lift the air cleaner from the carburettor. Re-fit the air cleaner by positioning the rubber grommet (2) on the air cleaner, fitting the cleaner to the carburettor and tightening the screw.



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COOLING SYSTEM

DESCRIPTION

The cooling system is sealed, pressurized and thermostatically controlled, water circulation is assisted by an impellor type pump to which is attached a six-bladed fan assembly driven by a "V" belt from the crankshaft pulley.

Water drawn from the radiator bottom tank by the pump is fed into a brass tube in the cylinder head, a number of holes in the tube directing the coolant around the inlet and exhaust valve seats.

After circulating around the remainder of the combustion head and cylinder block, the water returns to the radiator header tank via a passage in the water pump body, top water elbow and hose. A small by-pass drilling is provided between the inlet and outlet passages of the pump body to allow water to circulate when the thermostat is closed.

THERMOSTAT

This is incorporated in the cooling system to enable the engine to warm up more rapidly by restricting the flow water to the radiator until the engine reaches its normal working temperature.

As the temperature of the engine increases, the thermostat opens, allowing the coolant to circulate past the thermostat valve and into the radiator.

FILLER CAP, FIGURE 1

The special filler cap is fitted to the radiator top tank incorporates a spring-loaded rubber-faced valve which seals the cooling system, until a pressure of 6 1/4 to 7 1/4 lbs. per sq. in. (4 to 5 kg/cm) is generated. At this pressure the release valve opens and allows excess pressure to escape through the release pipe.

By pressurizing the system, the boiling point of the water is raised, so enabling the engine to operate at higher temperature.

To relieve the vacuum which is created as the system cools, a small spring-loaded relief valve built into the centre of the filler cap, opens to admit atmospheric pressure.

CAUTION

If the engine is hot, exercise, extreme care when removing the filler cap. Turn it half-turn and allow pressure to be fully released before completely removing the cap, figure 2.

DRAINING

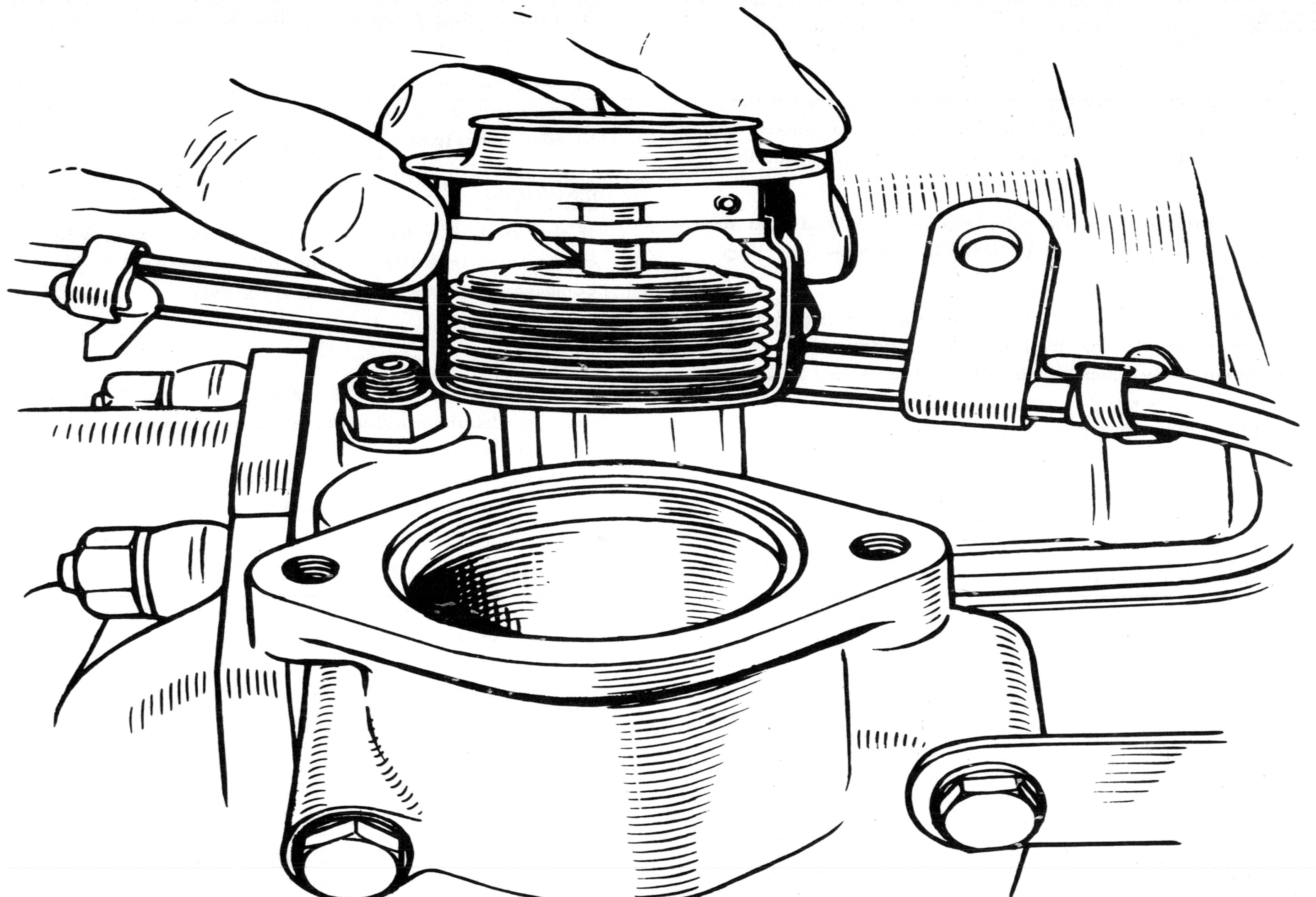
To drain, open the drain tap situated in the bilge on the heater hose, remove attached nylon hose, placing end outside the door, open drain plug at the rear of cylinder block on the left-hand side, open the heater air vent, and owing to the system being pressurized it is also necessary to remove the radiator filler cap.

FILLING

When filling, close the drain tap, and then fill the system with water (if available, clean rain water). After filling start the engine to circulate the coolant through the heater unit. When the coolant is warm, stop the engine and top up the radiator to the correct level if necessary.

FLUSHING

Efficient cooling is maintained by thoroughly flushing the entire system twice a year. The seasons most suitable for this service are during autumn before adding anti-freeze mixture and during spring immediately after the anti-freeze has been drained off.



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Before flushing the system, remove the filler cap and open the drain taps (or preferably completely remove them), whilst the engine is still hot. Allow time for the engine to cool after the water has been drained. When cold, insert a hose in the radiator filler neck and flush the system to remove all sediment.

Slude which may have collected in the heater unit should also be removed by disconnecting the heater feed pipe and attaching it to a high pressure hose. When draining is complete, reconnect the heater and close the drain taps or re-fit them if they have been removed. Fill the system to the normal level with a solution of cleansing compound and run the engine as directed by the manufacturers of the compound. It is most important that the compound is drained off after the period described, finally flush the system thoroughly with running water.

IMPORTANT

When using cleansing solutions, avoid splashing the paintwork of the vehicle as this may have injurious effects.

THERMOSTAT, FIGURE 1

The thermostat is housed in the upper portion of the water pump body, its flange being located between the upper recessed face of the latter and the joint face of the water outlet elbow.

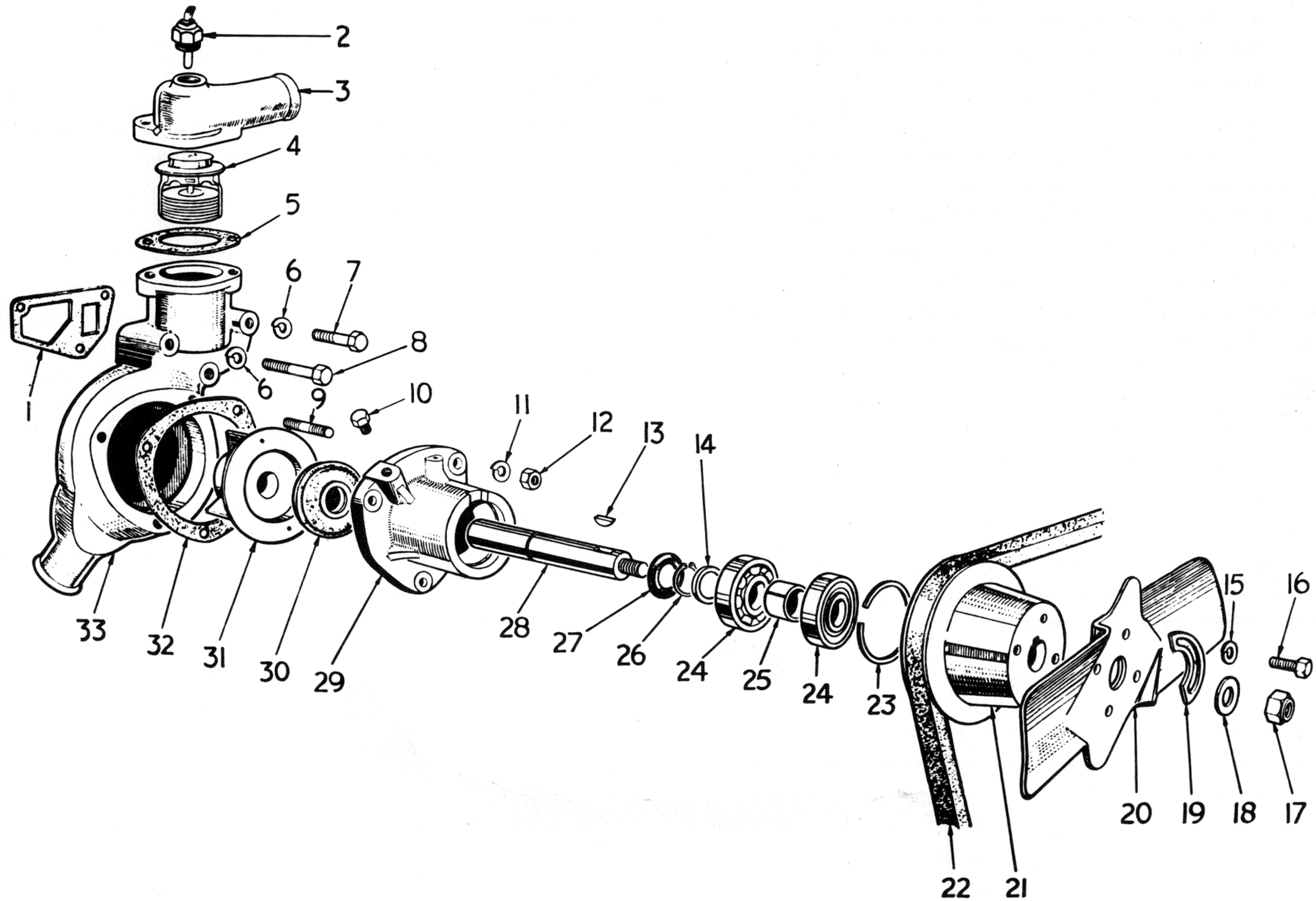
TESTING

The thermostat may readily be tested for correct operation by placing it, together with an accurate thermometer, in a bowl of water. Raise the temperature at which the thermostat valve commences to open. This should be within the tolerances given in the technical data. Provided that the opening temperature is within these limits, there is no need to check the temperature at which the thermostat valve is fully open, as this automatically follows.

The element is not adjustable or repairable and when a test shows inaccuracies or damage on inspection, it will be necessary to renew the complete unit.

REFITTING

Clean the pump body and elbow joint faces, use a new joint washer and reverse the removal procedure. Refill the radiator.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WATER PUMP REMOVAL

The water pump assembly is secured to the cylinder head by three baits of unequal length. The upper left-hand bait being used to also secure the generator adjusting link. Drain the cooling system and remove the pump as follows:

1. Slacken the two generator baits and remove the adjusting bolt together with two plain washers. Move the generator towards the cylinder block and remove the fan belt.
2. Disconnect the top and bottom water hoses from the pump body. If a heater is fitted, it will also be necessary to disconnect the return pipe by slackening the union nut from the rear of the pump body.
3. Remove the bolts securing the pump body to the cylinder head and lift the complete pump assembly from the engine.

NOTE: Provided that the radiator is first removed the water pump bearing housing can be detached separately if required, leaving the pump body in position.

REFITTING

Renew all joint washers and reverse the removal procedure.

DISMANTLING, FIGURE 1

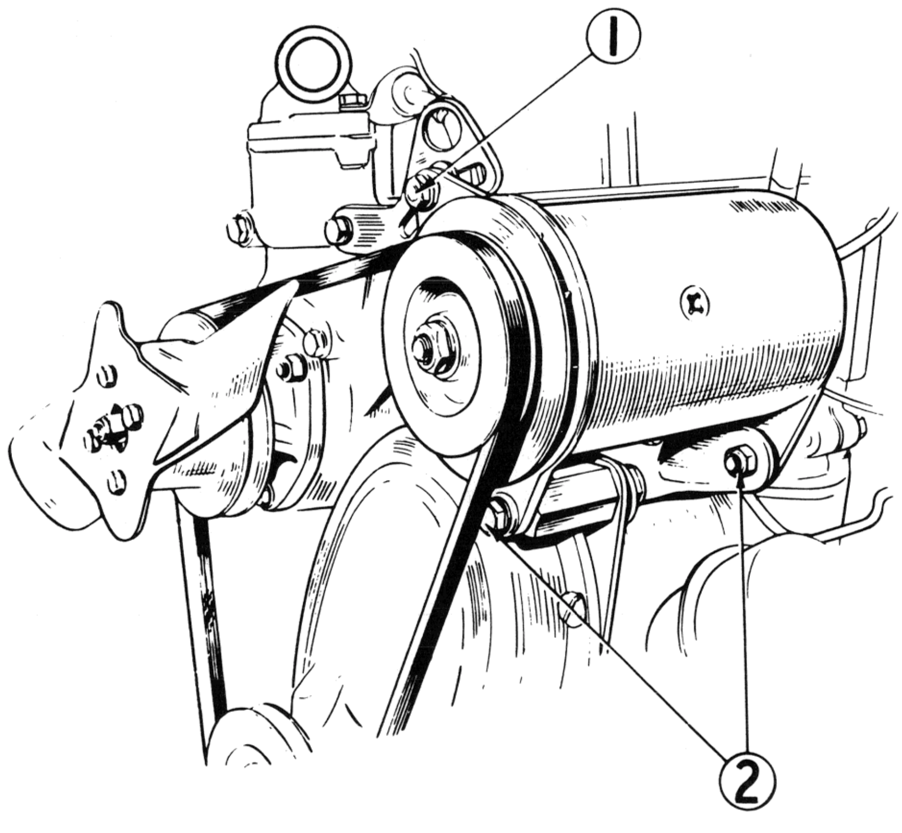
1. Withdraw the four retaining screws (16) and remove fan blades (20) together with the balancer (19) (if fitted).
2. Remove the nut (17) and washer securing the fan pulley (21) and using a suitable extractor, withdraw this from the spindle (28).
3. Having withdrawn the impeller (31) from the pump spindle (28) by utilizing an extractor remove the bearing retaining circlip from the housing bore and withdraw the spindle complete with bearings.
4. Remove the following items from the spindle-key (13), bearings (24), distance piece (25), circlip (26), washer (14), and rubber spinner (27).
5. Complete the pump dismantling by removing the sealing gland (30) from the recess in the back of the impeller.

RE-ASSEMBLY

Reverse the dismantling procedure and note the following points.

1. When fitting the bearings, repack these with pump grease and position them so that the grease seal incorporated in each bearing faces outwards. Pack the inside of the seal bellows with water pump grease.
2. Press the impeller on to the shaft until a clearance of 0.030" (.76 mm) is obtained between the bearing housing and the impeller. Before fitting the bearing assembly, solder the impeller to the shaft to prevent the possibility of water leakage along the spindle.

During manufacture, the fan and pulley assembly are statically balanced by adjusting the length of the fan blades. Final adjustment is then made by attaching and moving a balance weight (19) to the desired position. When the fan, pulley and balance weight are in perfect balance, the position of these items is marked by drilling a small hole through the complete assembly.



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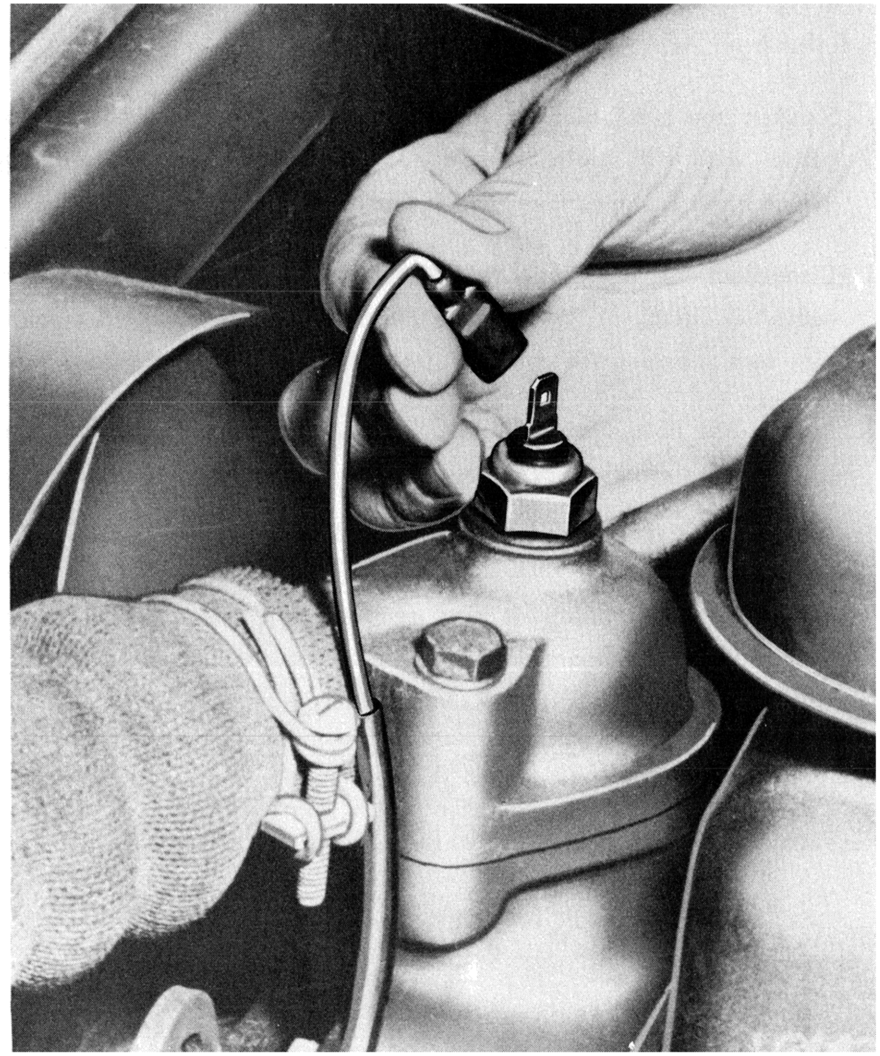

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To maintain the original degree of balance when the components are reassembled the drillings should be aligned by inserting the shank of a 1/16" (1.6 mm) drill through the holes whilst the fixing bolts are being tightened.

FAN BELT ADJUSTMENT, FIGURE 1

Slacken the bolt (1) and generator pivots (2), swing the generator outwards until there is approximately 1" (25.4 mm) side movement in the belt at its longest run, i.e. between crankshaft pulley and generator.

Maintaining the belt tension, retighten the bolt (1) and generator pivots (2).

Do not over-tension the belt as excessive loads will be imposed on the generator and water pump bearings.

TRANSMITTER (THERMOMETER), FIGURE 2

The transmitter is mounted in the top water elbow, and the gauge unit, which is mounted in the instrument panel, both units are connected by a cable.

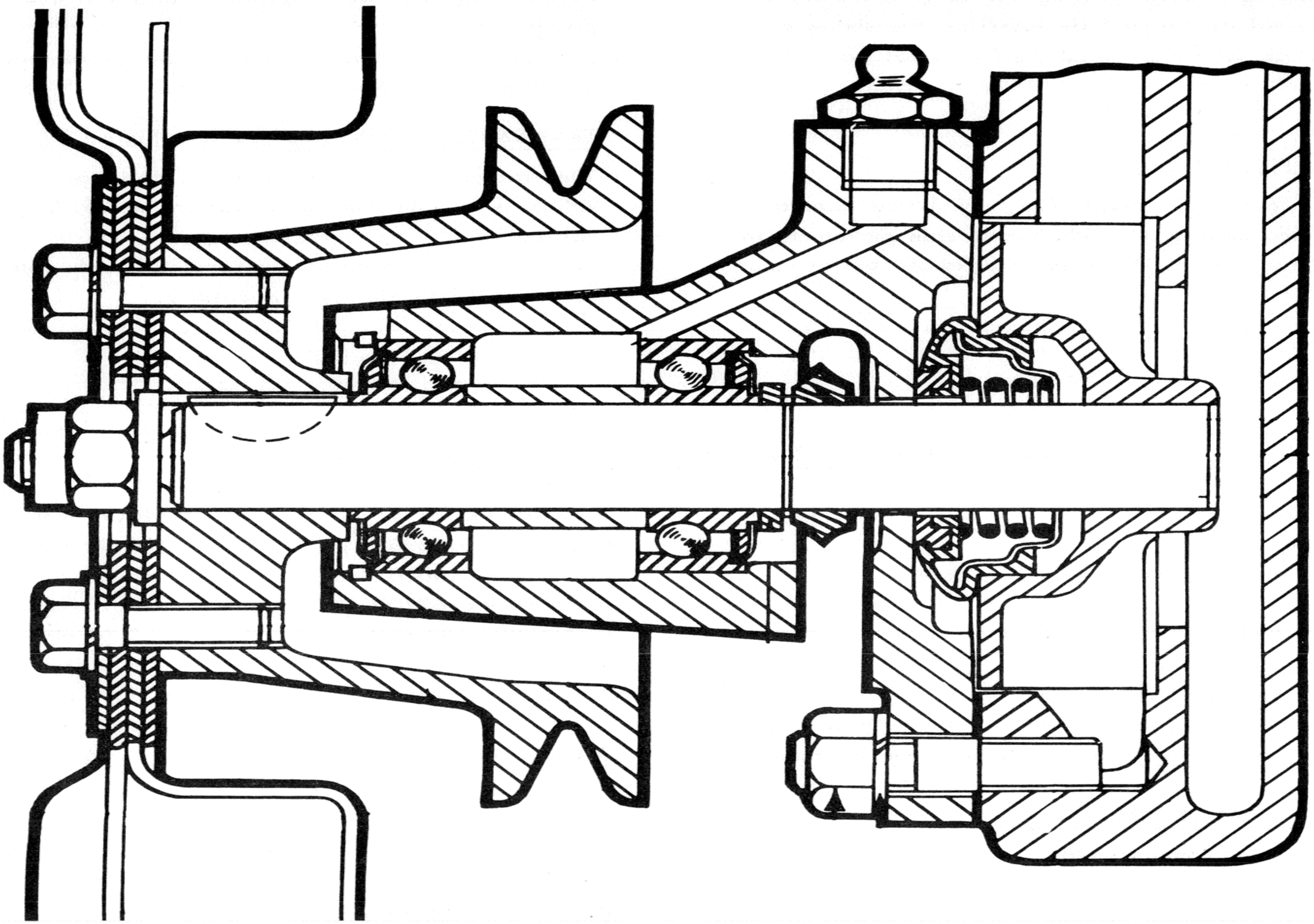
No provision is made for the repair of these components, but they may be renewed independently if necessary.

WATER PUMP DIMENSIONS AND TOLERANCES

Fan pulley bore	0.6296" - 0.6291"	15.99 mm - 15.98 mm
Dia. of spindle	0.6299" - 0.6296"	16.0 mm - 15.99 mm
Interference between spindle and pulley bore	nil - 0.0008"	nil - 0.02 mm
Impeller bore	0.6265" - 0.6270"	15.93 mm - 15.91 mm
Interference between spindle and impeller bore	0.0026" - 0.0034"	0.07 mm - 0.09 mm
Bearing housing internal diameter	1.3779" - 1.3773"	35.0 mm - 34.98 mm
Depth of gland face below joint face	0.235” - 0.225"	5.97 mm - 5.71 mm
Maximum permissible depth of gland face below joint face	0.265”	6.7 mm
Distance between impeller and joint face of bearing housing	0.030"	0.76 mm

COOLING SYSTEM THERMOSTAT

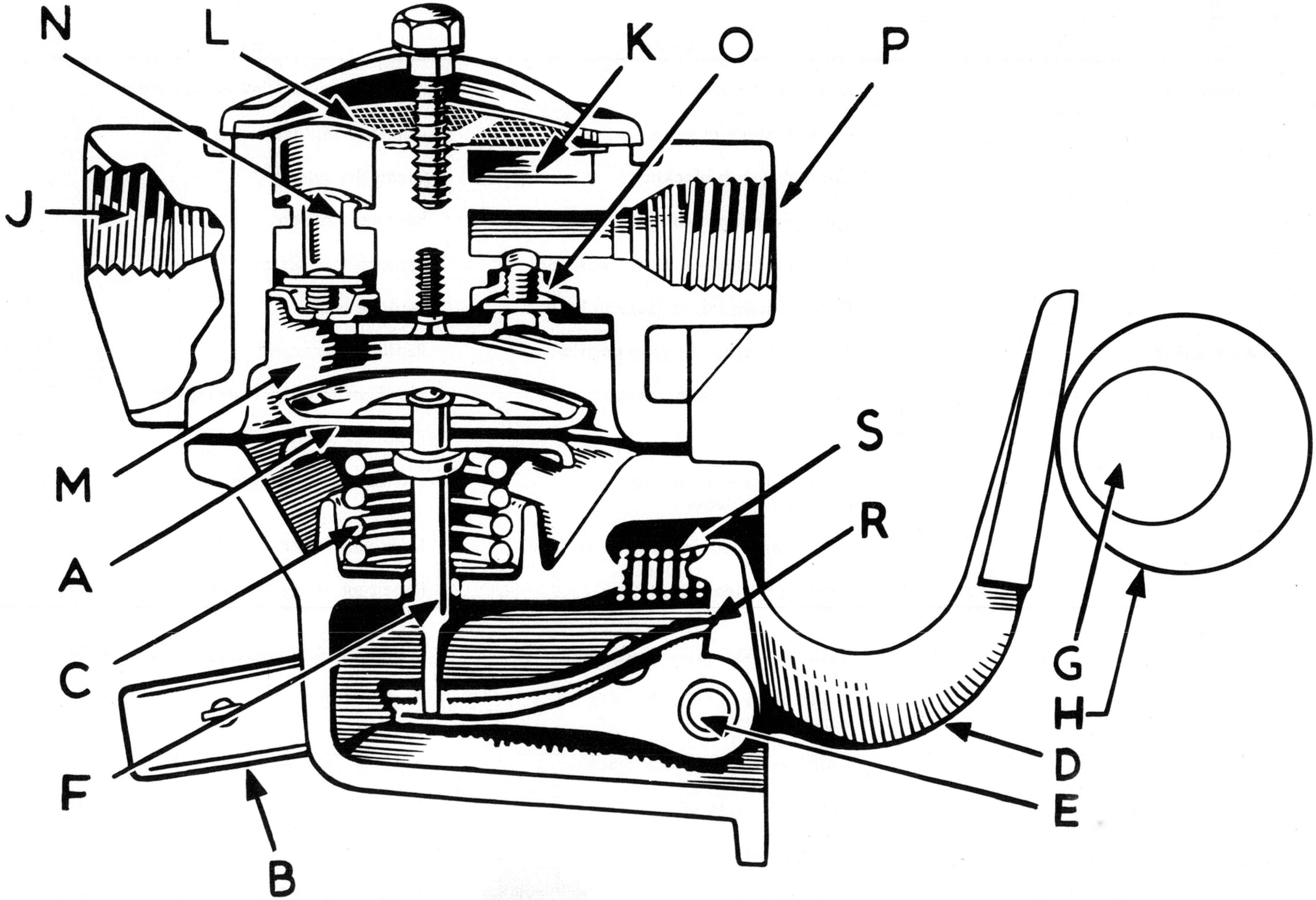
Thermostat opening commences at	154º F to 163.4º F
Fully open at	185º F
Maximum lift	0.312" (7.92 mm).



COOLING SYSTEM

FAULT DIAGNOSIS

Fault	Cause	Remedy
Overheating	Insufficient coolant	Refill system and inspect for leaks
	Fan belt slack or worn	Adjust or replace
	Cooling system blocked	Clean the system
	Ignition timing incorrect	Re-time ignition
	Thermostat stuck in closed position	Replace thermostat
	Radiator hose fabric loose in bore	Replace hose
Overcooling	Thermostat stuck in open position	Replace thermostat
	Extremely low temperatures	Blank off lower part of radiator
Loss of water	Radiator leaking	Repair or renew radiator
	Radiator hoses defective or hose clips loose	Tighten clips or replace hoses
	Water pump leaking	Overhaul water pump
	Heater unit leaking	Repair or renew heater element or connections
	Cylinder head gasket defective	Replace gasket and tighten nuts evenly
	Welsh plugs in cylinder head or block leaking	Renew plugs
	Cylinder head or block cracked	Replace cylinder head or block
Water pump noisy	Pump bearing rough	Renew spindle and bearings
	Seal squeaking	Replace seal
	Belt squeaking	Dress sides of belt with dressing or soap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DESCRIPTION OF THE FUEL SYSTEM

The fuel system of the "Amphicar" comprises of the fuel tank with filler cap, fuel cock, fuel hose, fuel pump with pipe and carburettor with air filter.

The fuel tank is located below the trunk lid, its capacity being 12,4 U.S. galls. = 47 liters. The fuel cock is screwed into a welded-on nozzle at the discharge opening of the fuel tank.

The fuel is drawn by the fuel pump from the fuel tank and is then delivered to the carburettor.

The fuel cock cup and strainer should be removed and cleaned every 6000 miles, for foreign matters and even water will accumulate in the strainer, and if left too long without being cleaned, it could cause clogging of the carburettor jets.

ANCILLARY EQUIPMENT

FUEL PUMP

Attention to the fuel pump may be restricted to cleaning the fitter bowl, and ensuring that the attachment bolts and pipe unions are tightened sufficiently to prevent leaks.

CARBURETTOR

The single Solex carburettor installation requires little attention. This may be confined to cleaning out the float chamber and jets.

FUEL PUMP, FIGURE 1

The fuel pump is an A. C. mechanically operated diaphragm type pump which is mounted on the side of the engine, and is driven by an eccentric of the camshaft.

As the camshaft (G) turns, the cam (H) lifts the pump rocker arm (D) pivoted at (E) which pulls the rod (F) together with the diaphragm (A) downwards against the compression spring (C) thus creating a vacuum in the pump chamber (M) .

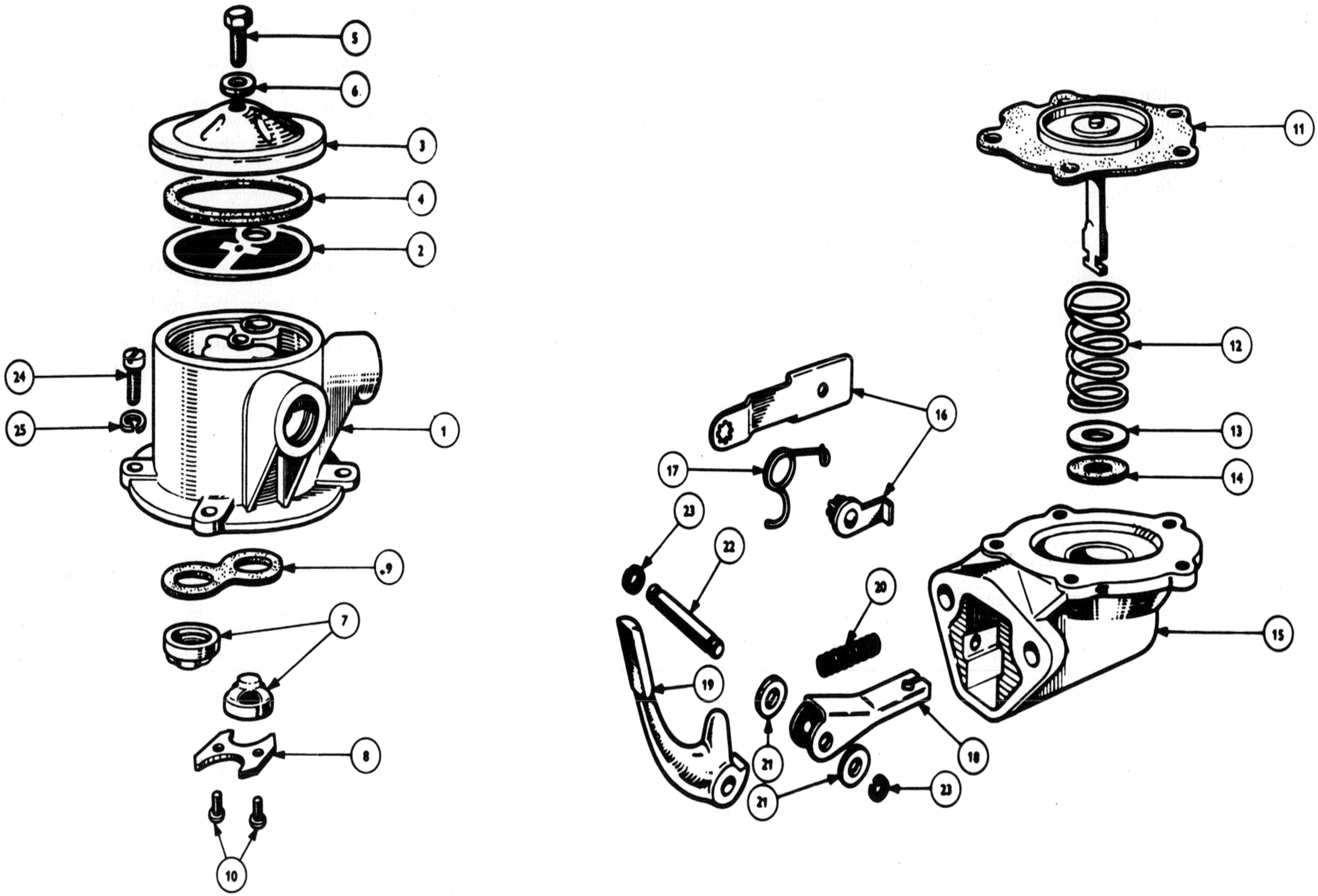
The fuel is drawn from the tank and enters at (J) through a gauze filter screen and inlet valve (N) into the pump chamber (M). On the return stroke the compression spring (C) pushes the diaphragm upwards, forcing fuel from the pump chamber through the delivery valve (0) and outlet (P) to the carburettor.

The fuel delivery is automatically regulated according to engine requirements. The spring (S) keeps the rocker arm (D) in constant contact with the push-rod and the eccentric (H) to eliminate noise.

CLEANING FILTER

It is advisable to examine the filter every 3.000 miles (5.000 km) and clean if necessary. Under conditions of dust-laden atmosphere this interval should be reduced as conditions dictate. Access to the filter is gained by removing the dome cover, after unscrewing the retaining screw, when the filter gauze itself may be lifted off its seating as shown in figure 1 clean the filter gauze with air jet or gasoline and replace the cork gasket if this is hardened or is broken.

When refitting the cover, make certain that the fibre washer is replaced under the head of the screw. Tighten the filter cover retaining screw just sufficiently to make a leak-proof joint. Complete this service by checking the pump attachment screws and the fuel pipe unions for tightness.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FUEL PUMP DISMANTLING, FIGURE 1

After removing the pump from the engine and before commencing dismantling operations, thoroughly wash the pump exterior with paraffin to remove all dirt and grease. To ensure that the components are reassembled in their original position, mark across the diaphragm flanges of the pump with the sharp edge of a file. Having removed the securing screws and separated the two main castings, further dismantling of the components associated with each is quite straight forward. The diaphragm and pull rod assembly can be withdrawn by pressing down and turning it through 90 degrees.

NOTE: Being permanently riveted together, no attempt should be made to separate the diaphragm layers from their protective washers and pull rod, as this is at all times serviced as a complete assembly.

INSPECTION OF PARTS

All parts must be thoroughly cleaned to ascertain their condition. Wash all parts associated with the valves in a clean paraffin bath separate from that employed for the other and dirtier components. Diaphragm and pull rod assemblies should normally be replaced unless in entirely sound condition without any signs of cracks or hardening of the diaphragm layers.

The upper and lower castings should be examined for cracks or damage and if the diaphragm or pump mounting flanges are distorted, these should be lapped to restore their flatness. All bad parts should be replaced and very little wear should be tolerated on the rocker arm pin (22), the holes and engagement slot in the link (18) and the hole in the rocker arm (19). On the working surface of the rocker arm, which engages with the camshaft eccentric slight wear is permissible, but should not exceed 0.010" (0.254 mm) in depth. The valve seat incorporated in the valve plate (7) should be examined, and if at all roughened, it should be carefully lapped on a smooth carborundum stone. Similarly, the corresponding outlet valve seat incorporated in the upper casting (1) should be examined and, if worn unevenly, both the upper casting and valve seat assembly must be replaced. It is not practicable to refit new valve seats into the castings, as this calls for special equipment.

Fuel pump valves (7) should be replaced if at all worn, although in an emergency they can be turned over to provide a fresh surface to the valve seat. Valve springs should preferably be replaced, although they can be refitted, providing that they do not bear undue evidence of rubbing away on the outside diameter. In no circumstances should valve springs be stretched in an endeavor to increase their length.

Diaphragm spring (12) seldom calls for replacement, but where necessary ensure that the replacement spring has the same identification color and consequently the same strength as 'he original. All gaskets and joint washers should be replaced as a matter of routine.

RE-ASSEMBLY OF FUEL PUMP

Proceed as follows:

A) UPPER PORTION

Having swilled the valves in clean paraffin, fit the valve in the centre of the four cast webs.

Place the valve (7) on the valve seat located in the upper casting.

Fit on the top of the valves the gasket (9) and the valve plate (8) which is then secured with the two screws (10) .

At this stage, use a piece of wire to make sure that the valves work freely. Place the filter screen (2) in position on top of the casting, making certain that this fits snugly.

Fit cork gasket (4), cover (3), fibre washer (6) and retaining screw (5) as previously detailed under "cleaning filter".

B) LOWER PORTION

Assemble the link (18), packing washers (21), rocker arm (19) and rocker arm spring (20) in the body.

Insert the rocker arm pin (22) through holes in the body, simultaneously engaging the packing washers, link and rocker arm, then spring the retaining clips (23) into the grooves on each end of the rocker arm pin. The rocker arm pin should be a tap fit in the body. If necessary, in order to achieve this fit, it is permissible to burr the edges of the pinholes.

NOTE: The fitting of the rocker arm pin can be simplified by first inserting a piece of 0.240" (6.096 mm) diameter rod through the pin hole in one side of the body far enough to engage the rocker arm washers and link and then pushing the rocker arm pin in from the opposite side, removing the temporary rod as the pin takes up its proper position.

C) DIAPHRAGM ASSEMBLY TO PUMP BODY

Insert the fabric washer (14), metal washer (13) and place the diaphragm spring (12) in position on the pump body. Place the diaphragm assembly (11) over the spring, the pull rod being downwards, and centre the upper end of the spring in the lower protector washer.

Press downwards on the diaphragm until the slots on the pull rod engage with the fork in the link, then turn the diaphragm assembly a complete quarter turn to the right, which will place the pull rod in the proper working position in the link and at the same time permit matching up of the holes in the diaphragm with those on the pump body flanges. When inserting the diaphragm assembly into the pump body the locating "tab" on the outside of the diaphragm assembly should be at 6 o'clock position. After turning the diaphragm assembly a quarter turn to the left, the "tab" should be at 3 o'clock position.

D) RE-ASSEMBLY OF UPPER AND LOWER SUB-ASSEMBLIES

Push the rocker arm towards the pump until the diaphragm is level with the body flanges. Place the upper half on the pump into the proper position, i.e., aligning the two marks made during dismantling operations. Install the cover screws and lock washers and tighten only until the heads of the screws just engage the washers. Hold the rocker arm at its innermost position and, whilst thus held, tighten the cover screws diagonally and securely.

TESTING THE PUMP AFTER RE-ASSEMBLY

The best method is by using an A. C. bench test stand on which the inlet side of the pump is piped to a tin of clean fuel at floor level and the outlet side of the pump connected to a stop tap and pressure gauge.

First flush the pump through to wet the valves and seats, and then completely empty it again by continuing to operate the rocker arm by hand with the inlet pipe clear of the fuel. Again operate the pump. Not more than twenty strokes should be necessary to secure delivery of fuel from the pump outlet.

With the same apparatus a second test can be made by working the pump with the tap on the delivery side closed, pressure then being recorded on the gauge. After ceasing to work the pump it should take several seconds for this pressure to return to zero, thus denoting that the valves are seating properly.

Also whilst there is pressure, the outer edge of the diaphragm, visible between the pump body flanges, should be carefully examined for leakage and the retaining screws tightened if necessary. When working the pump by hand, a somewhat longer stroke is obtained and the pressure developed may be higher than when fitted to the engine.

OPERATING PRESSURE

The fuel pump is designed to operate at a pressure of 1 1/2 to 2 1/4 lbs. per sq. in. (1 to 16 kg/cm^2). If the pressure exceeds this figure, flooding of the carburettor is liable to occur, with a resultant rich mixture and heavy fuel consumption.

Where necessary, a reducing in fuel delivery may be obtained by inserting additional paper joints between the pump flange and mounting face on the block, thus reducing the effective stroke of the pump diaphragm.

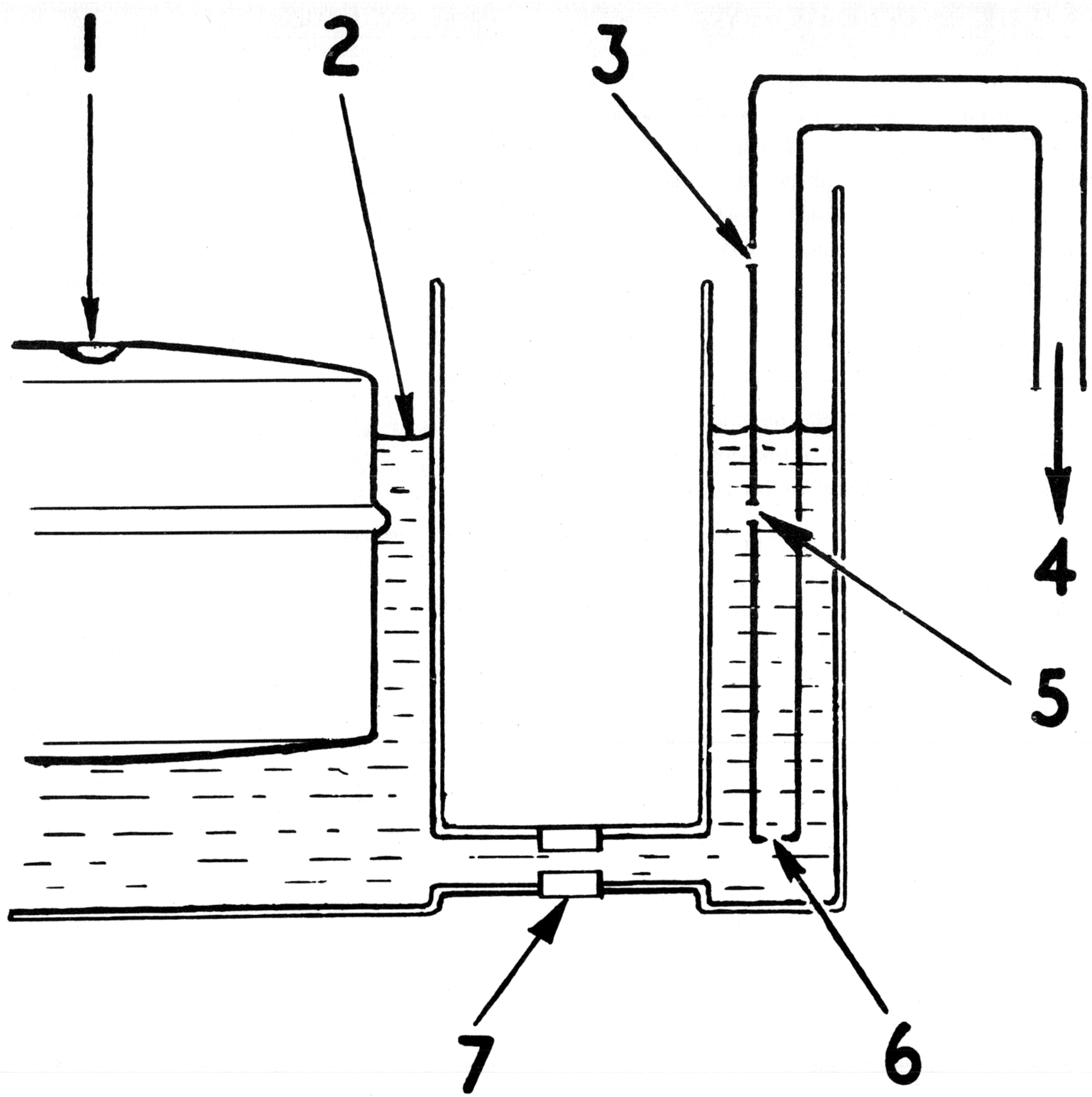
NOTE: The actual mounting of the pump on a particular engine affects the fuel delivery owing to machining tolerances of the flange faces. Therefore, testing the pump pressure by means of the priming lever or by mounting it on a jig may give a false result. The pump pressure should be checked with the unit in its normal position by rotating the engine with the starter.

REFITTING THE PUMP

Position the same thickness of joint washers on the mounting studs as were removed, then refit the pump taking care that the rocker arms contact the camshaft eccentric correctly. Re-connect the fuel pipes to the pump.

THE SOLEX B.30 ZIC.5 CARBURETTOR

The Solex B 30. ZIC. 3 and B.30 ZIC.5 carburettors are similar in construction and principles of operation to the B 28 ZIC.2 model carburettor. The B.30 ZIC.5 carburettor has, however, a modified cold starting system and incorporates an external float chamber air vent.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The cold starting system consists of a starter fuel jet (7) in the side of the float chamber. This jet supplies fuel from the float chamber to a well in the carburettor body. A tube which is partly immersed in fuel in the well is pressed into the carburettor top cover at its upper end and communicates with the cold starter unit through a passage cast in the top cover. The tube has a small hole (3) near its upper end which is open to atmosphere, and a larger hole (5) approximately half way down the tube, which, in the static condition, is below the fuel level in the well. The cold starting unit itself is otherwise similar to that used on the B.28 ZIC.2 carburettor. When starting the vehicle from cold, pulling the choke knob out brings the cold starting unit into operation.

The depression created by rotation of the crankshaft causes fuel to be drawn up the tube. The fuel is emulsified by air drawn through the small bleed hole (3) and then passes through the cold starter unit, supplying a rich initial starting mixture. If the engine does not start immediately, the fuel level in the well falls rapidly and uncovers the larger hole (5), which further emulsifies the starting mixture to prevent over-richness. A short pause when attempting to start the engine will enable the well to re-fill through the starter fuel jet, again providing an initially rich mixture when cranking is re-commenced. When the engine starts, the increased depression acting on the starter unit disc valve lifts it from its seat and admits more air. The mixture is progressively weakened as the choke knob is pushed in until, when the engine is sufficiently warm the cold starting unit is put out of action.

SOLEX B.30 P.S.E.I. CARBURETTOR

DESCRIPTION

The 30 mm Solex B.30 P.S.E.I. carburettor is dust proofed and incorporates a strangler with automatic mixture weakening characteristics, a special Econostat fuel economy device and a mechanically-operated acceleration pump.

OPERATION, FIGURE 1, PAGE 78

1. STRANGLER

The strangler consists of a butterfly valve (2), mounted on an off-set spindle. Operation of the dashboard control opens the throttle (23) slightly and at the same time, by means of an interconnecting rod and cam, closes the butterfly valve.

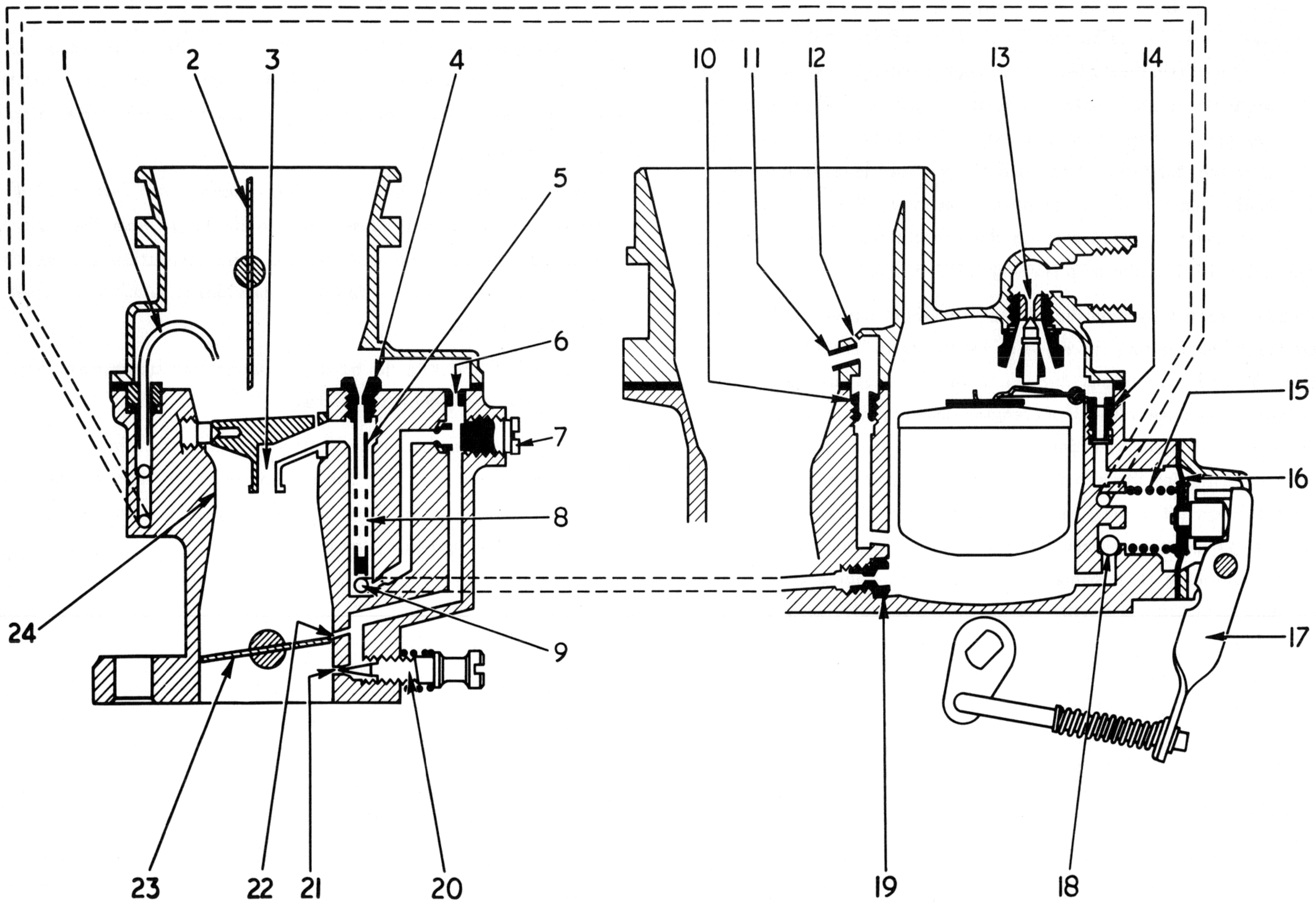
Depression created in the cylinder and inlet manifold when the crankshaft is rotated causes fuel to discharge from the main spraying well (8) through the orifice (3). The restriction on the air intake imposed by the strangler butterfly provides a suitably enriched mixture for cold starting.

Opening of the throttle by a pre-determined amount provides for fast idling after the engine has started.

The increase in depression acting on the carburettor when the engine fires causes the strangler butterfly to pivot on its offset spindle against the resistance of a light coil spring, thus admitting more air and automatically weakening the mixture.

2. IDLING CIRCUIT

The idling circuit supplies, through the orifice (21), the mixture required for idling when the engine is warm. It also supplies, through the by-pass orifice (22), the mixture required as the throttle is opened, but before it opens enough for the main spraying orifice to begin to discharge. Fuel is supplied from the reserve well (9) and is metered by the pilot jet (7), the pilot jet air bleed (6) emulsifying the mixture from (7). When the engine is idling, additional air passes through the by-pass orifice (22), the volume of the resultant mixture being controlled by the screw (20) .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On leaving the idling orifice (21) the mixture is further emulsified by air passing the throttle (23) which is held slightly open by the idling speed adjustment screw. As the throttle is opened, manifold depression is directed to the by-pass orifice (22) which discharges additional mixture to meet engine requirements until the throttle has opened sufficiently for the main spraying system to come into operation.

3. MAIN SPRAYING CIRCUIT, FIGURE 1

As the throttle (23) is opened further and air speed through the choke tube (24) increases, depression acting on the spraying orifice (3) brings the main spraying system into operation. Under this condition fuel flows from the float chamber and is metered by the main jet (19) before passing into the main spraying well (9) fuel in the main spraying well (9) is emulsified with air metered by the air correct on jet (4). Air from the correction jet (4) enters the fuel stream through small holes in the emulsion tube (5). From the main well the mixture finally discharges through the orifice (3) into the main air stream.

As the engine speed increases the fuel level in the well (9) falls and uncovers the remaining holes in the emulsion tube (8). Additional air enters the fuel stream through the uncovered holes in the emulsion tube and corrects the fuel output from the main jet according to engine speed and load.

4. ACCELERATION PUMP

The acceleration pump consists of a diaphragm (16), spring (15) and lever (17). The lever is connected by a push rod to a crank on the end of the throttle spindle.

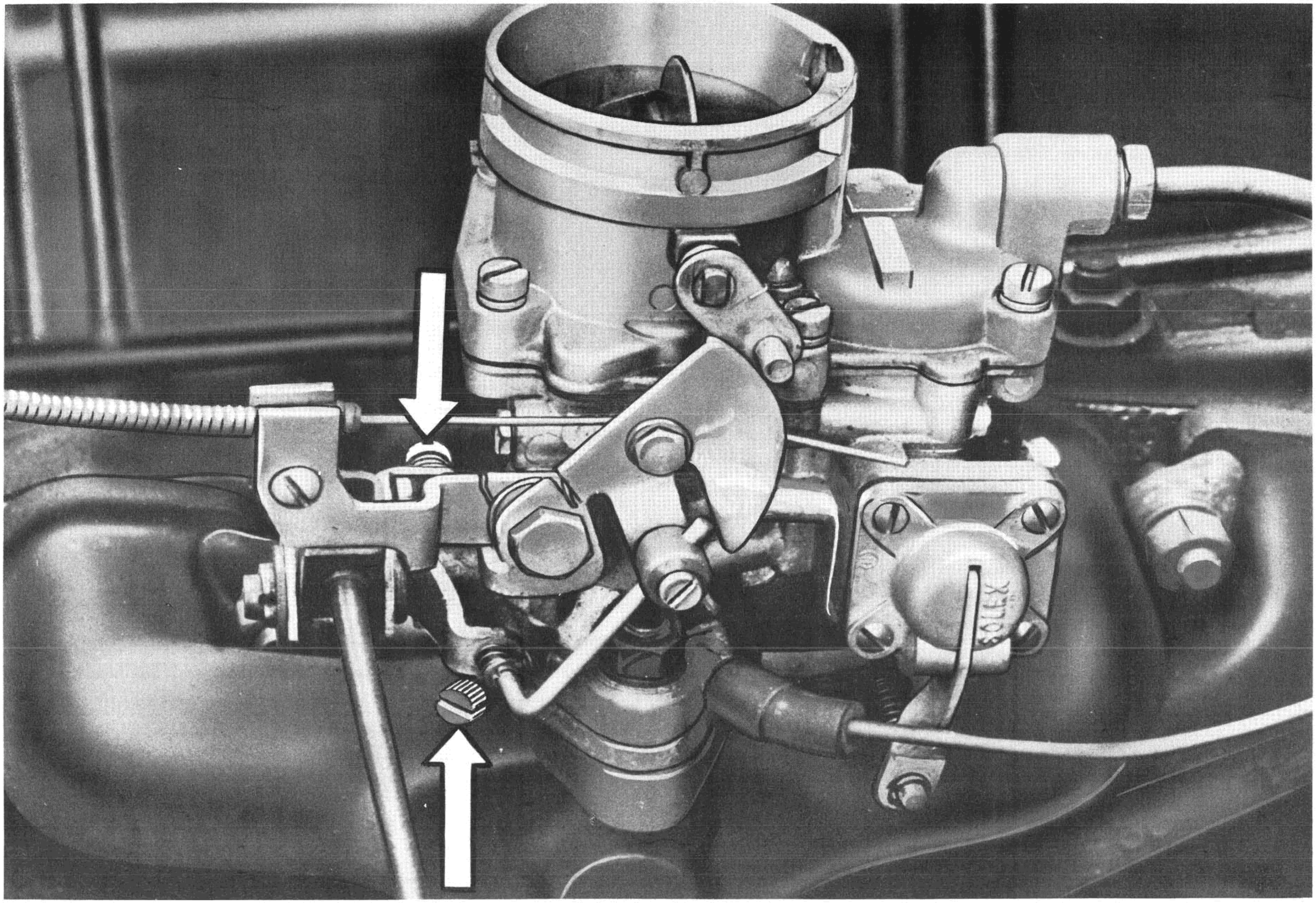
KEY TO FIGURE 1

1. Accelerator pump jet.
2. Strangler flap.
3. Main spraying orifice.
4. Air correction jet.
5. Emulsion tube.
6. Pilot jet air bleed.
7. Pilot fuel jet.
8. Air emulsion holes.
9. Main spraying well.
10. Econostat fuel jet.
11. Econostat discharge tube.
12. Econostat air bleed.
13. Needle valve.
14. Accelerator pump breather valve.
15. Accelerator pump diaphragm spring.
16. Accelerator pump diaphragm.
17. Accelerator pump lever.
18. Non-return ball valve.
19. Main jet.
20. Idling mixture volume adjustment screw.
21. Idling mixture orifice.
22. Secondary idling mixture orifice.
23. Throttle disc.
24. Choke tube.

Depression of the accelerator pedal moves the actuating rod and lever, causing the pump diaphragm to be displaced against the force of the spring (15). The pump diaphragm (16) forces fuel through the calibrated pump jet (1) into the main air stream, providing a momentarily enriched mixture for rapid acceleration. A non-return valve (18) prevents fuel returning to the float chamber when the pump diaphragm is displaced. An anti-siphon valve is provided to prevent over-spill from the pump injector pipe, which could cause difficult hot re-starting.

5. ECONOSTAT CIRCUIT

The econostat circuit maintains maximum fuel economy over the cruising speed range of the engine whilst providing accurate metering of the fuel under full throttle conditions


SOLEX

The circuit comprises an air bleed (12) and fuel jet (10) providing an emulsified mixture that is discharged into the air intake above the choke tube (23).

As the engine speed increases the discharge will take place only when the depression inside the discharge tube (11) has become great enough to lift the fuel up to the inner end of the discharge tube. The depression inside the tube is determined by the depression at the outer end of the tube and the relative sizes of the air bleed (12) and outlet orifice. The size of the air bleed (12) determines the point at which the econostat comes into operation and the jet (10) controls the rate at which the fuel is supplied. The econostat thus supplements the mixture supplied by the main jet from a pre-determined engine speed up to maximum r.p.m. This allows the main jet to be of a size to give maximum cruising speed economy, whilst over-richness under full throttle conditions at low engine speed is avoided.

6. FUEL LEVEL

The level of fuel in the float chamber is controlled by slight rise and fall of the float, closing or opening the needle valve to cut off or admit fuel from the pump as required.

STARTING THE ENGINE FROM COLD

Pull the strangler control knob on the dashboard out to its maximum travel. Starting the engine in moderate climates may be accomplished with the mixture control in the half-way position. Switch on the ignition and operate the starter motor until the engine fires. Do not depress the throttle pedal.

As soon as the engine gathers speed, push in the strangler control knob to approximately a quarter of its travel.

The vehicle may then be driven away, and the strangler control pushed progressively in as soon as possible.

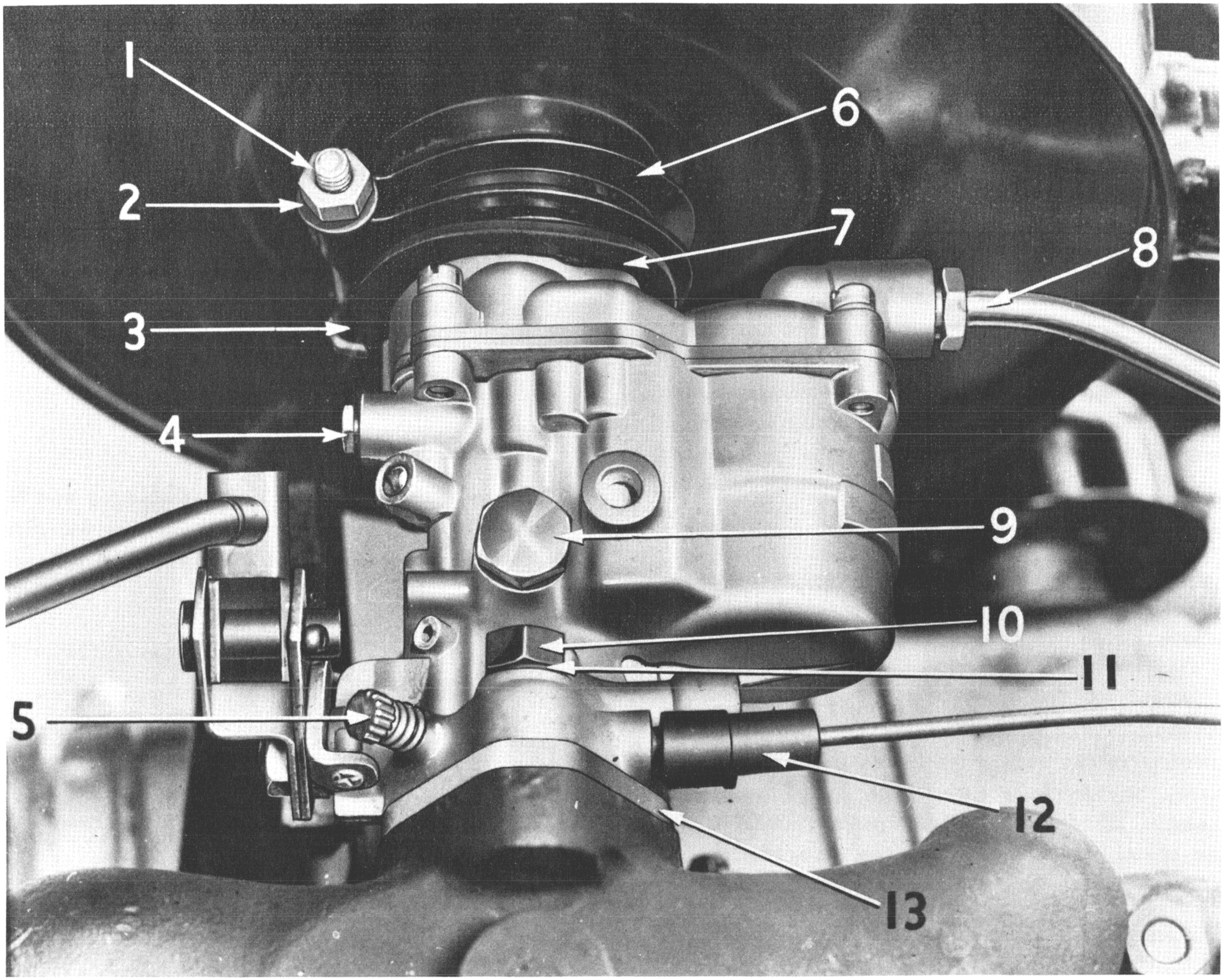
HOT RE-STARTING

Do not use the strangler control when the engine is warm. If the engine and ambient temperatures are high and it does not start at the first attempt, depress the throttle pedal approximately one-third of its travel and maintain this position whilst operating the starter motor until the engine fires. Do not pump the throttle pedal.

IDLING ADJUSTMENT, FIGURE 1

To obtain perfect idling, the engine compression must be good and equal, tappet clearances, distributor point gap and ignition timing correct and the sparking plugs clean and set to the correct gaps as detailed.

1. Set the throttle (slow-running adjustment) screw until the idling speed is approximately 500 r.p.m.
2. Unscrew the volume control screw (20) until the engine begins to hunt.
3. Screw it in again until the hunting disappears and the engine idles smoothly.
4. If the engine speed has risen then reset the slow running screw to bring it back to about 500 r.p.m.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5. This may cause a slight resumption of hunting. If so, gently screw in the volume control screw (20) until idling is perfect. (Under no circumstances should (20) be screwed hard home).

REMOVAL

1. Slacken the clip (6) figure 1 and detach the air cleaner assembly.

   Disconnect the fuel pipe (8) and detach the vacuum ignition control pipe by withdrawing the rubber sleeve (12) from the stub pipe on the carburettor.

2. Release the strangler inner and outer cables (4) from the abutment bracket and cam plate solderless nipple.

3. Disconnect the throttle cable (5) from the throttle lever. Remove the nuts (10) figure 1, spring washers (11) and detach the carburettor from the manifold, followed by the flange gasket (13).

RE-FITTING

Re-fit the carburettor by reversing the foregoing dismantling procedure. Fit a new gasket (13) and adjust the length of the inner strangler cable so that when the strangler knob is fully in, the strangler butterfly cam plate is against its stop on the abutment bracket.

DISMANTLING AND CLEANING, FIGURE 1, PAGE 84

Periodically, dismantle the carburettor to clean out the float chamber jets and passages as follows:

Detach the air cleaner and disconnect the fuel pipe.

Remove the screws (3), spring washers (4) and detach the top cover (5) and gasket (6). Lift out the spindle (60), float lever (59) and float (7).

Remove the plug (51), aluminum washer (52) and using a long screwdriver, remove the main jet (53).

Unscrew the pilot jet (14) and the air correction jet (8) from the carburettor body (11). Remove the valve (54) and plunger (58). Then detach the accelerator pump nozzle (57), taking care to catch the ball valve (55) from beneath it.

Detach the screw (43) from the accelerator pump body (42), remove the body and swing it to one side on the pump lever.

Remove the diaphragm (46) and spring (47). Take care not to lose the ball valve (45) from its seating within the accelerator pump chamber.

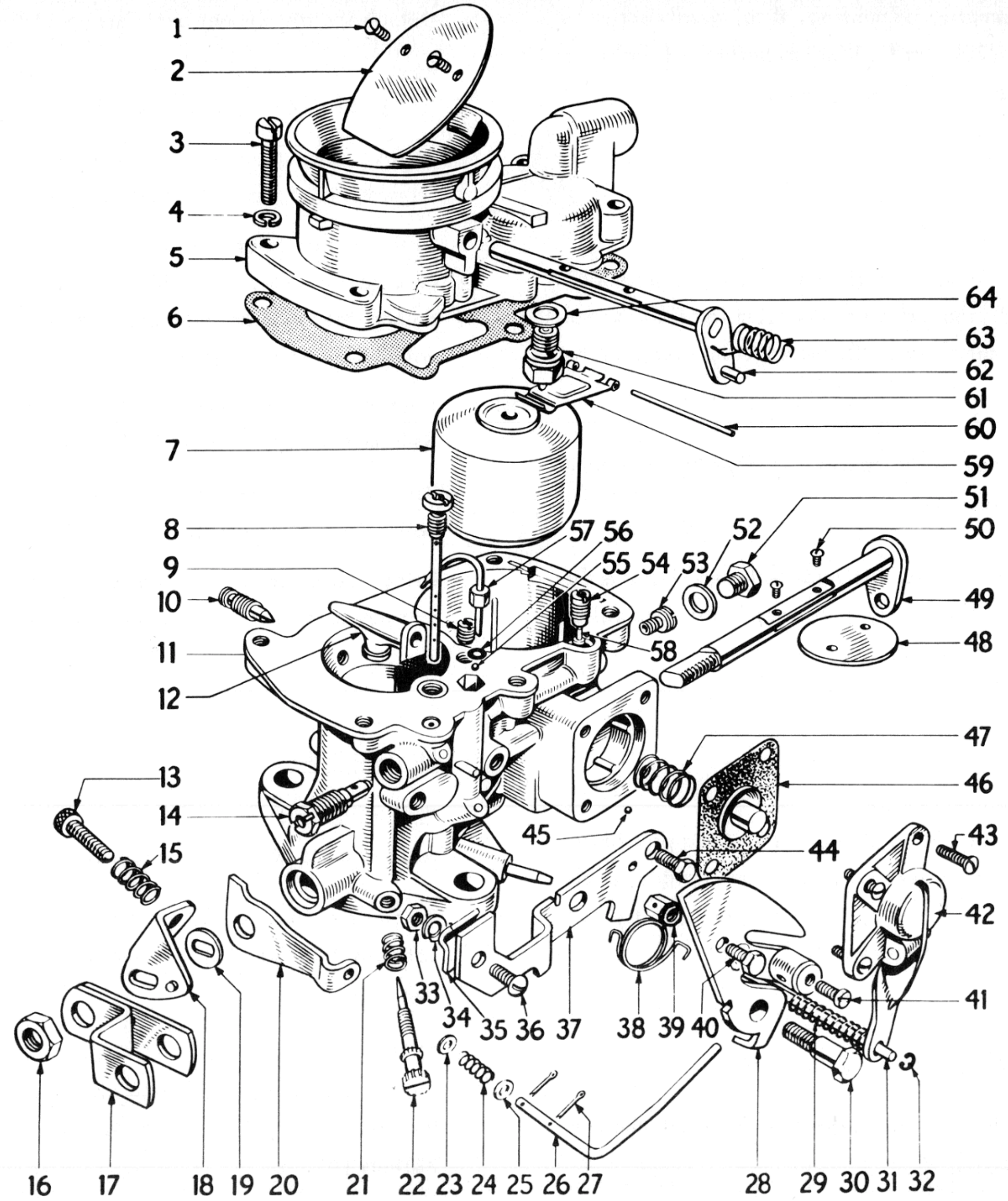
Using clean fuel and a compressed air line, clean out the float chamber, and passages within the carburettor body and the various jets.

RE-ASSEMBLY

Re-fit the ball (45), spring (47), diaphragm (46) with its boss outwards and the pump body (42), securing these with the screw (43).

Re-fit the main jet (53), washer (52) and plug (51), the pilot jet (14), compensating jet (8), non-return valve (55) and accelerator pump nozzle (57).

Fit the float (7), lever (59) and spindle (60). Position a new gasket (6) on the carburettor body, hold the strangler butterfly open and fit the top cover (5) to the body, securing with the screw (3) and spring washers (4).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Re-connect the fuel feed pipe union and re-fit the air cleaner.

COMPLETE DISMANTLING

To completely dismantle the carburettor, carry out the foregoing dismantling operations plus the following:

TOP COVER. Remove the needle valve (61) and fibre washer (64). Detach the screw (1), withdraw the strangler butterfly from its slot in the spindle and then detach the spindle (62) and return spring (63) from the top cover (5).

MAIN BODY. Remove the nut (16), throttle lever (17), idling stop bracket (18), washer (19) and strangler inter-connection lever (20) from the throttle spindle. Remove the screw (50), slide the throttle butterfly (48) from its slot in the throttle spindle (49) and withdraw the spindle (49) by sliding it towards the front of the carburettor. Remove the circlip (32), detach the push rod (31) from the pump lever and remove the spring (29). Unscrew the rod (31) from the lever (49). Slacken the screw (41) and detach the connecting rod (26) and lever (20). Withdraw the split pins (27) and remove the washer (23) followed by the lever (20), spring (24) and second washer (25).

Remove the idling mixture adjusting screw (22) and spring (21). Withdraw the econostat jet (9) from the carburettor body.

Remove the set screw (44), pivot bolt (30) and detach the cam plate (28), spring (38) and abutment bracket (37). Release the screw (10) and withdraw the spraying assembly (12) from the carburettor.

RE-ASSEMBLY

Re-assemble the carburettor by reversing the dismantling procedure, but note the following:

The return spring (38), on the cam plate pivot bolt (30), must be fitted with the narrow hook in the slot of the cam plate (28).

The return spring (63), must be fitted with the hooked end over the strangler lever (62) .

Fit the circlip (32) on to the first groove in the accelerator pump connection rod (31).

Adjust the length of the throttle strangler interconnecting rod (26) by inserting a length of 0.027" (0.7 mm) dia. Rod between the throttle butterfly and the bore of the carburettor body; then, with the strangler butterfly fully closed, tighten the screw (41).

FUEL CONSUMPTION

Should complaints be made about excessive fuel consumption it is not always the case that the fault is due to the carburettor.

In the following enumeration of causes first the factors are mentioned which are of decisive importance on the fuel consumption of a vehicle.

1. Manner of driving and operation of the car.
2. Speed.
3. Terrain (level ground, upland, high mountains).
4. City traffic, door to door traffic, etc.
5. Condition of car.
6. Tire pressures.
7. Atmospheric influences.
8. Condition of roads (snow, slippery roads, etc.)

The proper consumption figure may, therefore, be computed only when taking these factors into account. In general, the average touring consumption is 10% above the standard consumption. Constant city driving in un-even districts, frequently in low gear, the consumption may eventually rise considerably above the average consumption.

STANDARD FUEL CONSUMPTION

The fuel consumption figures stated by the car manufacturers are based on general directions for the evaluation of fuel consumption, they are shown in standard specification DIN 70030 of the standard association of motive vehicle industries. Therefore car owners are able to check the fuel consumption figures for correctness when referring to the above standard specification.

The standard fuel consumption may be determined in the following manner.

1. VEHICLE - Correct carburettor adjustment and ignition timing. Tire pressures, viscosity of the engine and gearbox oil must meet the manufacturers specifications. The engine must be run-in and brought to its usual operational temperature before the test is made.
2. LOAD - The vehicle must be loaded to a weight between full load and empty.
3. TEST ROAD - A dry level highway approximately about 7 miles long. Grades of short length and docents with a maximum gradient of 1,5%. In and return without interruption.
4. WEATHER CONDITIONS - Must be dry, and wind still.
   Air temperature + 50 to 860 F.
5. SPEED - If possible drive at 3/4 of the stopped top speed throughout the entire test.
6. FUEL - Commercial grade of fuel.
7. MEASURING DEVICE - The fuel quantity consumed during the fuel consumption test must be determined exactly in a calibrated measuring vessel, a quantity of 0.1 ltr.
8. CALCULATION OF FUEL CONSUMED - The consumption should be calculated according to the following formula:

   KN = 1,1 K/W X 100

   KN = Fuel consumption in liter/100 km.

   W = Distance covered in km.

   K = Quantity of fuel consumed.

The tolerance of 10% included in this formula serves to compensate for unfavorable conditions. For checking the standard fuel consumption a tolerance of +5% is admissible. Therefore, the consumption figure determined on a trial run may be compared with the standard consumption figure given by the car manufacturer only if the above described test conditions are prevailing. In most cases a higher consumption will result as a consequence of wrong uneconomical driving methods or of unfavorable test run condition.

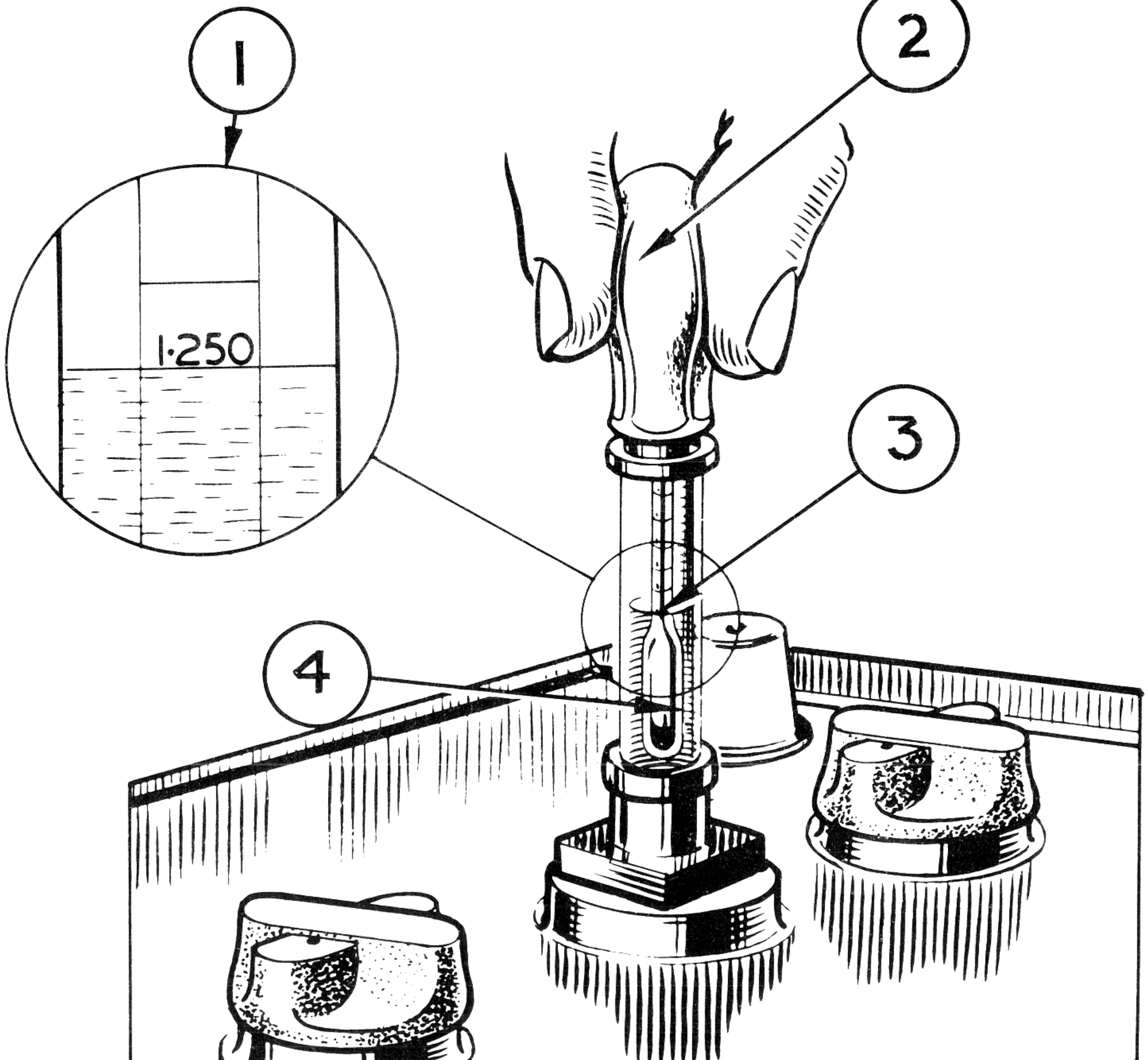
If in spite of the observance of all test conditions as specified, the consumption stated exceeds the standard fuel consumption by more than 5%, it is good practice to make a new adjustment, or to check the engine and running gear for proper condition.

In doing so, the following hints should be taken into consideration:

1. Check for leakages of the fuel system.
2. Check carburettor float.
3. Check needle valve.
4. Damaged or leaking fuel pump diaphragm.
5. Excessive pump pressure.
6. Check sparking plugs.
7. Wrong timing.
8. Burnt valves.
9. Worn or broken piston rings.
10. Engine oil of the wrong viscosity rating.
11. Dragging brakes (handbrake).
12. Thick tread of tire, cross country M and S tyres.
13. Insufficient tire pressures.

All of these points must be taken into consideration for it, should be the cause of high fuel consumption.

Fault and Cause		Remedy
Excessive fuel consumption	High pump pressure	Reduce fuel delivery by fitting extra washers behind pump. Check diaphragm spring tension.
Insufficient washer thickness beneath needle valve		Fit thicker fibre washers.
Leakage from jets, past face of starter disc valve, or leaking jet gland packing		Tighten jets, reface starter disc valve, renew gland packings.
Faulty needle valve seating		Clean or replace needle valve.
Punctured float		Check and replace if faulty.
Faulty ignition		Check and rectify if faulty.
Incorrect adjustment		Re-adjust.
Poor slow running and starting	Blocked manifold pipe	Check and clean.
Induction air leak		Check manifold and carburettor joints. Replace if required.
Loss of compression		Check and re-grind valve seats if required.
Chocked jet		Remove and clean jets.
Faulty ignition	Induction air leak	Check and rectify. Check and replace manifold and carburettor joints.
Loss of compression		Check and re-grind valve seats if required.
Throttle not opening fully		Check and adjust limit stop or cable.
Fuel starvation		Check delivery from pump needle valve for sticking and blocked jets.
Air cleaner chocked		Remove and clean.
Silencer chocked		Check and replace if faulty.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ELECTRICAL AND IGNITION EQUIPMENT

BATTERY

Battery persists in a low state of charge. First consider the conditions under which the battery is used. If the battery is subject to long periods of discharge without suitable opportunities for re-charging, a low state of charge can be expected. Neglect of the battery during a period of low or zero mileage may be responsible for the trouble. A defect in the charging system can also result in a discharged battery.

VENT PLUGS

See that the ventilating holes in each vent plug are clear.

LEVEL OF ELECTROLYTE

The surface of the electrolyte should be level with the top of the separator guard. If necessary, top up with distilled water. Any loss of acid from spilling or spraying (as opposed to the normal loss of water by evaporation) should be made good by dilute acid of the same specific gravity as that already in the cell.

CLEANLINESS

See that the top of the battery is free from dirt or moisture which might provide a discharge path. Ensure that the battery connections are clean and tight.

HYDROMETER TEST, FIGURE 1

Measure the specific gravity of the acid in each cell in turn with a hydrometer to avoid misleading readings, do not take hydrometer readings immediately after topping-up.

The readings given by each cell should be approximately the same. If one cell differs appreciably from the others, an international fault in the cell is indicated.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives an indication of the state of plates. If the electrolyte is very dirty, or contains small particles in suspension, it is possible that the plates are in a bad condition.

The specific gravity of the electrolyte varies with the temperature, therefore, for convenience in comparing specific gravities, this is always corrected to 60º F, which is adopted as a reference temperature. The method of correction is as follows:

For every 5º F below 60º F deduct .002 from the observed reading to obtain the true specific gravity at 60º F.

For every 5º F above 60º F add .002 to the observed reading to obtain the true specific gravity at 60º F. The temperature must be that indicated by a thermometer actually immersed in the electrolyte, and not the air temperature.

Compare the specific gravity of the electrolyte with the valves given in the table and so ascertain the state of charge of the battery. If the battery is in a discharged state, it should be re-charged, either on the vehicle by a period of daytime running or on the bench from an external supply.

DISCHARGE TEST

A heavy discharge tester (150 - 160 amps) consists of a voltmeter 2 or 3 volts full scale, across which is connected a shunt resistance capable of carrying the current. Point prongs are provided for making contact with the intercell connectors.

A good cell will maintain a reading of 1.2 - 1.5 volts, depending on the state of charge, for at least 6 seconds. If, however, the reading rapidly falls off, the cell is probably defective. This test should not be carried out immediately after the car has completed a journey otherwise a misleading reading may be obtained.

RECHARGING FROM AN EXTERNAL SUPPLY

If the above tests indicate that the battery is merely discharged, and is otherwise in a good condition, it should be recharged, either on the vehicle by a period of daytime running or on the bench from an external supply.

Climates ordinarily below 90º F (32º C). Specific gravity of electrolyte, corrected to 60º F.

Climates frequently over 90º F (32º C). Specific gravity of electrolyte, corrected to 60º F.

STATE OF CHARGE

	15,6º C	15,6º C
Fully charged	1.270 - 1.290	1.210 - 1.230
About half discharged	1.190 - 1.210	1.130 - 1.150
Completely discharged	1.110 - 1.130	1.050 - 1.070

If the latter, the battery should be recharged at the rate given, until the specific gravity and voltage show no increase over three successive hourly readings. During the charge the electrolyte must be kept level with the top of the separator guard by the addition of distilled water.

A battery that shows a general falling-off in efficiency, common to all cells, will often respond to the process known as "cycling". This process consists of fully charging the battery as described and then discharging it by connecting it to a lamp board, or other load, taking a current equal to the charging current.

The battery should be capable of providing this current for at least 7 hours before it is fully discharged, as indicated by the voltage of each cell falling to 1.8. If the battery discharges in a shorter time, repeat the cycle of charge and discharge.

MAINTENANCE

After filling, a dry-charged battery needs only the attention normally given to other lead-acid type batteries.

GENERAL

Examine the level of the electrolyte in the cells and if necessary, add distilled water to bring the level up to the top of the separators.

The use of a battery filler will be found helpful when topping-up. Ensure that the battery filler is filled with distilled water and insert it into a filler plug orifice until it rests gently on the separators. Sufficient water will pour into the cell to bring the electrolyte to its correct level. Check each cell in turn.

IMPORTANT

Never use a naked light when examining the battery as the mixture of oxygen and hydrogen given off by the battery can be dangerously explosive.

Examine the battery terminals and, if necessary, clean and coat them with petroleum jelly. Wipe away any foreign matter or moisture from the top of the battery and ensure that the connections and fixings are clean and tight.

IGNITION COIL

Model	L.A. 12
Primary resistance (at 68º F 10º C)	3.2 to 3.4 ohms.
Running current at 1000 r.p.m.	1.25 amps.

IGNITION COIL

The ignition coil is an oil filled hermetically sealed unit.

A coil, which has become suspect, should be tested in conjunction with the distributor.

The only maintenance which is required is to keep it and the surrounding area clean, by a coil break, then it must be replaced.

DISTRIBUTOR

The ignition distributor is mounted on the side of the cylinder block, and is driven in a counter clockwise direction by the oil pump shaft, which is driven by a skew gear on the camshaft.

On the distributor driving shaft, immediately beneath the contact breaker, is a centrifugally operated timing control mechanism. It consists of a pair of spring loaded governor weights, linked by lever action to the contact breaker cam. At low engine speeds, the spring force maintains the cam in a position in which the spark is slightly retarded.

Under the centrifugal force imparted by high engine speeds, the governor weights swing out against the spring pressure to advance the contact breaker cam, and thereby the spark, to suit engine conditions at the greater speed.

A built-in vacuum-operated timing control is also included, designed to give additional advance under part-throttle conditions. The inlet manifold of the engine is in direct communication with one side of a spring-loaded diaphragm. This diaphragm is linked to the contact breaker plate and rotates the contact breaker heel about the cam, thus advancing the spark for part-throttle operating conditions.

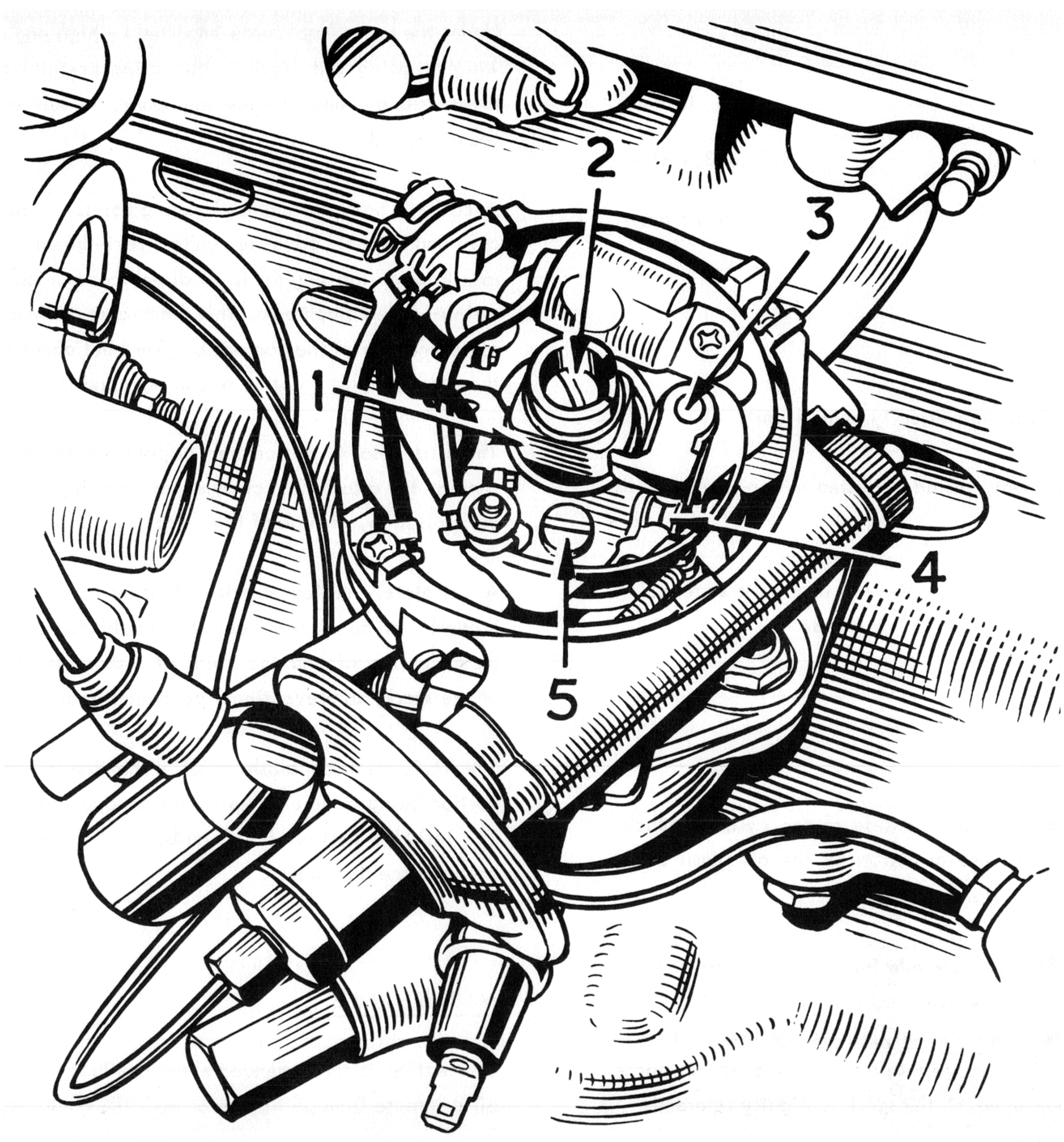
There is also a micrometer adjustment for making fine alterations in timing to allow for changes in running conditions, e.g. state of carbonization, change of fuel, etc.

A completely sealed metallized paper capacitor is utilized. This has the property of being self healing, should the dielectric break down, the metallic film around the point of rupture is vaporized away by the heat of the spark, so preventing a permanent short circuit.

The H.T. pick-up brush is of a composite construction, the middle portion being made of a resistive compound and the ends of softer carbon. The resistive portion of this carbon brush which is in circuit between the coil and the distributor.

MAINTENANCE

Lubrication is recommended every 6.000 miles taking great care to avoid oil or grease from getting on or near the contacts.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Add few drops of thin engine oil (S.A.E. 30) through the aperture at the edge of the contact breaker to lubricate the centrifugal timing control smear the cam with Mobilgrease No.2.

Lift off the rotor arm and apply to the spindle a few drops of Ragosine Molybdenised non-creep oil or thin machine oil to lubricate the cam bearing. It is not necessary to remove the exposed screw, since it affords a clearance to permit the passage of oil.

Replace the rotor arm, carefully, locating its moulded projection in the keyway in the spindle and pushing it on as far as it will go.

CLEANING - EVERY 6.000 MILES

Clean the distributor cover, inside and out, with a soft dry cloth paying attention to the spaces between the metal electrodes. Ensure that the carbon brush moves freely in its holder.

REPLACING THE CONTACTS

Worn contacts should never be renewed individually. If the contacts are worn badly, these must be removed and replaced with a new set to obtain satisfactory operation of the ignition system.

The contacts can be removed for cleaning or renewal as follows:

1. Disconnect the cables from the battery.
2. Take off the distributor cap and remove the rotor arm.
3. Remove the nut and insulating sleeve.
4. Lift off the moving contact assembly and insulating washer.
5. Remove the screw, spring washer, the plain washer, and then lift off the fixed contact plate.

Examine the contacting surfaces of both contacts for traces of burning and "pitting and piling".

Clean the contacts with a small carborundum stone, but care must be taken to keep the surfaces flat with each other to maintain maximum contact area.

"Pitting and piling" is inevitable after an extended mileage, but where this condition is excessive, a check should be made on the efficiency of the capacitor. This is best effected by substitution as relatively few people have access to an efficient capacitor tester.

The capacitor is secured to the base plate with one screw and shake-proof washer.

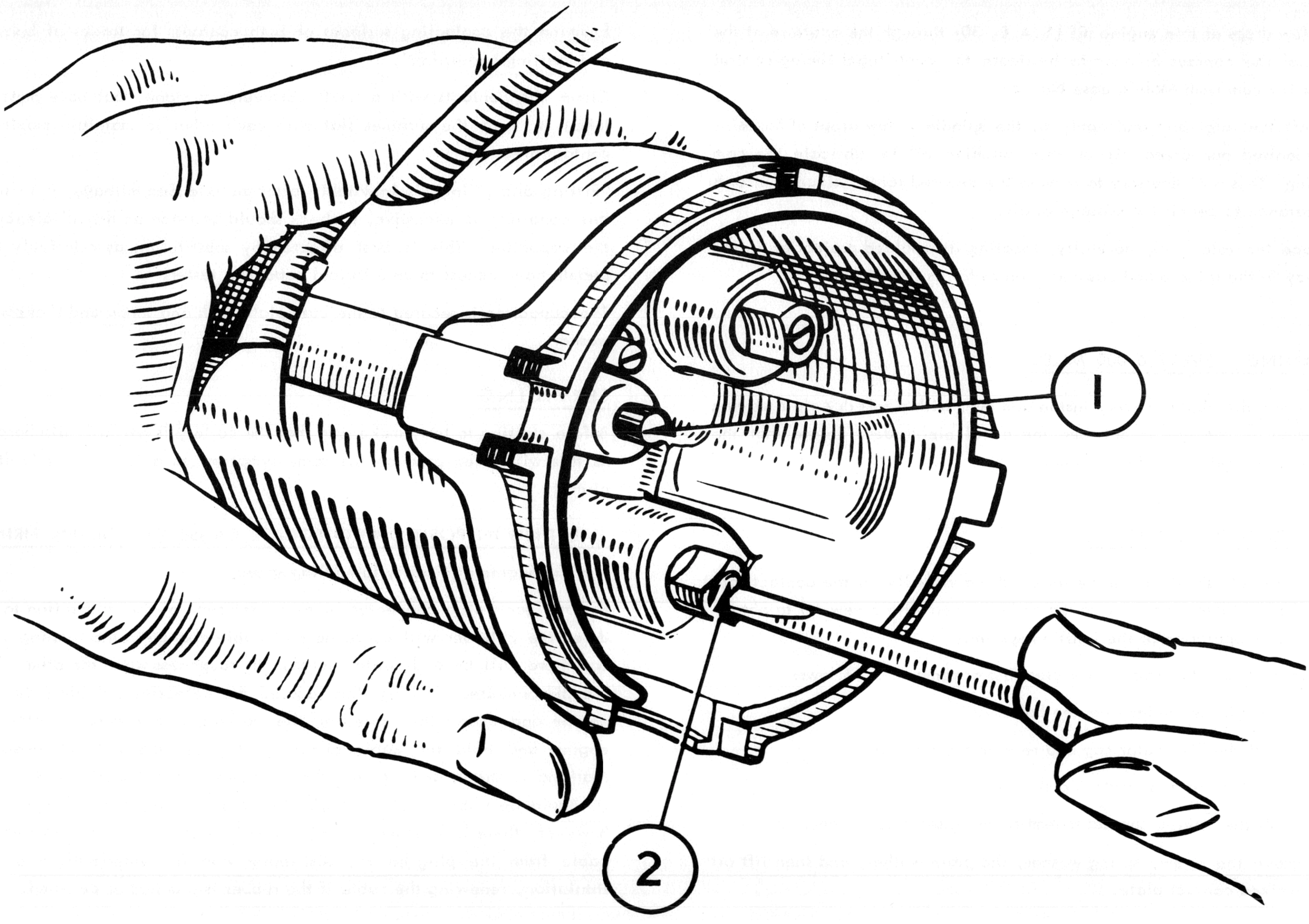
SERVICING

Before starting to test, make sure that the battery is not fully discharged, as this will often produce the same symptoms as a fault in the ignition circuit.

1. TESTING IN POSITION TO LOCATE CAUSE OF UNEVEN FIRING

Run the engine at a fairly fast idling speed.

Remove each plug connector in turn. Removal of the connection to the defective cylinder will cause no noticeable change in the running note, but there will be a definite increase in roughness when the other plugs are disconnected. Having thus located the defective cylinder, stop the engine and remove the cable from the sparking plug terminal. Restart the engine and hold the cable about 3/16" from the cylinder head. If sparking is strong and regular, the fault lies with the sparking plug, and it should be removed cleaned and adjusted, or a replacement fitted. If, however, there is no spark, or only weak irregular sparking, examine the cable from the plug to the distributor cap for deterioration of the insulation, renewing the cable if the rubber is cracked or perished.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ELECTRICAL AND IGNITION EQUIPMENT

Clean and examine the distributor moulded cap for free movement of the carbon brush. If a replacement brush is necessary, it is important that the correct type is used. If tracking has occurred, indicated by a thin black line between two or more electrodes or between one of the electrodes and the body, a replacement distributor cap must be fitted.

2. TESTING IN POSITION TO LOCATE CAUSE IF IGNITION FAILURE

Spring back the clips on the distributor head and remove the moulded cover. Lift off the rotor, carefully levering with a screwdriver if necessary.

Switch on the ignition and, whilst the engine is slowly cranked, observe the reading on an ammeter connected in series with the battery supply cable.

The reading should rise and fall with the closing and opening of the contacts if the low tension working is in order. When a reading is given which does not fluctuate, a short circuit, or contacts remaining closed, is indicated. No reading indicates an open circuit in the low tension circuit or badly adjusted or dirty contacts.

Check the contacts for cleanliness and correct gap setting as described. Ensure that the contact breaker lever moves freely on the pivot. If sluggish, remove the arm and polish the pivot post with a strip of fine emery cloth. Smear the post with Ragosine Molybdenised non-creep oil or Mobilgrease No. 2. Replace the lever. If the fault persists, proceed as follows:

3. LOW TENSION CIRCUIT - FAULT LOCATION

a. No reading in ammeter test.

Refer to circuit diagram and check circuit for broken or loose connections, including ignition switch. Check the ignition coil by substitution.

b. Steady reading in ammeter test.

Refer to circuit diagram and check wiring for indications of a short circuit.

Check capacitor (either by substitution or on a suitable tester).

Check ignition coil by substitution.

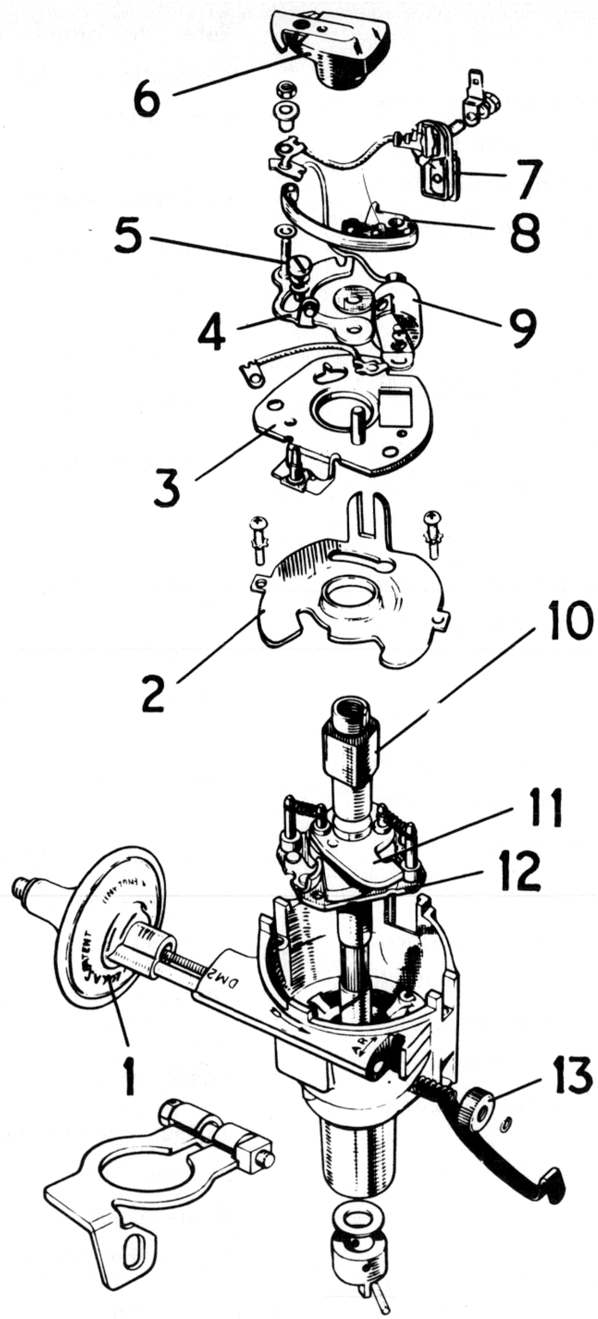
Examine insulation of contact breaker.

4. HIGH TENSION CIRCUIT

If the low tension circuit is in order, remove the high tension lead from the centre terminal of the distributor cap. Switch on the ignition and turn the engine until the contacts close. Flick open the contact breaker lever whilst the high tension lead from the coil is half about 3/16" from the cylinder block. If the ignition equipment is in good order, a strong spark will be obtained. If no spark occurs, a fault in the circuit of the secondary winding of the coil is indicated and the coil must be replaced.

The high tension cables must be carefully examined, and replaced if the rubber insulation is cracked or perished, using 7 mm neoprene-covered rubber ignition cable.

To make connections to the terminals in distributor cap, remove the cap and slacken the screws on the inside of the cap and push the cable firmly home in the holes in the cap. Tighten the screws, which will pierce the rubber insulation to make good contact with the cable core, figure 1.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The cables from the distributor to the sparking plugs must be connected in the correct firing order.

NOTE: The conductor in the cable between the coil and the top of the distributor is composed of carbon impregnated nylon cords which form a resistive path to the H.T. current.

This cable must not be replaced with cable having copper conductors. Special replacement cable is available from the factory parts division.

5. DISMANTLING, FIGURE 1

When dismantling, carefully note the positions in which the various components are fitted, in order to ensure their correct replacement on re-assembly. The tongue of the driving dog is offset; note the relation between it and the rotor electrode and maintain this relation when re-assembling the distributor. The amount of dismantling necessary will obviously depend on the repair required. Spring back the securing clips and remove the moulded cap. Lift the rotor arm off the spindle carefully levering with a screwdriver if it is tight.

Disconnect the vacuum unit link from the contact moving plate, and remove the two screws at the edge of the contact breaker base plate. The contact breaker assembly, complete with external terminal, can now be lifted off. Remove the circlip on the end of the micrometer timing screw, and turn the micrometer nut until the screw and the vacuum unit assembly are free. Take care not to lose the ratchet and coil type springs located under the micrometer nut.

The complete shaft assembly, with centrifugal timing control and cam foot can now be removed from the distributor body on knocking out the dog securing pin.

A) CONTACT BREAKER

To dismantle the assembly further, remove the nut, insulating piece and connections from the pillar on which the contact breaker spring is anchored. Slide out the terminal moulding.

Lift off the contact breaker lever and the insulating washers beneath it. Remove the screw securing the fixed contact plate, together with the spring and plain steel washers, and take off the plate. Withdraw the single screw securing the capacitor.

Dismantle the contact breaker base assembly by turning the base plate clockwise and pulling to release it from the contact breaker moving plate.

B) SHAFT AND ACTION PLATE

To dismantle the assembly further, take out the screw inside the cam and remove the cam and cam foot. The weights and springs of the centrifugal timing control can now be lifted off the action plate. Note that a distance collar is fitted on the shaft underneath the action plate.

6. RE-ASSEMBLY

The following instructions assume that complete dismantling has been undertaken.

a. Place the distance collar over the shaft, smear the shaft with Ragosine Molybdenised.

b. Refit the vacuum unit into its housing and replace the springs, milled adjusting nut and securing circlip.

c. Reassemble the centrifugal timing control. See that the springs are not stretched or damaged. Place the cam and cam foot assembly over the shaft, engaging the projections on the cam foot with the weights and fit the securing screw.

d. Before reassembling the contact breaker base assembly, lightly smear the plate with Ragosine Molybdenised non-creep oil or Mobilgrease No.2.

Fit the contact breaker moving plate to the contact breaker base plate and secure using a reversal of the dismantling procedure.

Refit the contact breaker base plate into the vacuum unit. Insert the two base plate securing screws, one of which also secures one end of the contact breaker earthing cable.

e. Refit the capacitor. Place the fixed contact plate in position and secure lightly with the securing screw. One plain and one spring washer must be fitted under the securing screw.

f. Place the insulating washers, etc., on the contact breaker pivot post and on the pillar on which the end of the contact breaker spring locates.

g. Slide the terminal block into its slot.

h. Thread the low tension connector and capacitor eyelets on to the insulating piece, and place these on to the pillar which secures the end of the contact breaker spring. Refit the washer and securing nut.

i. Set the contact gap to 0.014" to 0.016" and tighten the fixed contact securing screw.

j. Refit the rotor arm, locating the moulded projection in the rotor arm with the keyway in the shaft, and pushing fully home. Refit the distributor cap.

7. REPLACEMENT CONTACTS

If the contacts are so badly worn that replacement is necessary, they must be renewed as a pair and not individually.

The contact gap must be set to 0.014" to 0.016"; after the first 500 miles running the new contacts fitted, the setting should be checked and the gap reset to 0.014" to 0.016". This procedure allows for the initial "bedding-in" of the heel.

STARTING SYSTEM

GENERAL

The starting system comprises the battery, ignition and starter switch, starter solenoid and the starter motor.

IGNITION AND STARTER SWITCH

The starter ignition switch has three positions (1) "off", (2) "on" and (3) "start", the latter position being spring loaded which returns the switch to the "on" position when the key is released.

OPERATION

Turn the switch clockwise to switch "on", turn further clockwise against the spring pressure to energize the starter solenoid.

STARTER SOLENOID DESCRIPTION

The starter solenoid is an electro-magnetic switch housed within a cylindrical casting and located on the dash panel on the right-hand side of the engine compartment.

It is a sealed unit and cannot be dismantled for re-assembly.

GENERATOR

Model	C 39 PV-2 and C 40-1.
2 pole 2 brush	Shunt wound ventilated compensated voltage control.
Rotation	Clockwise (drive end).
Brush spring tension	22 to 25 ozs.
Cutting-in speed	
C 39 PV-2	1050 to 1200 r.p.m.
C 40-1	1250 to 1450 r.p.m.
Maximum output at 13.5 volts	
C 39 PV-2	19 amps, at 1900 to 2150 r.p.m.
C 40-1	22 amps, at 2050 to 2250 r.p.m.
Field resistance	
C 39 PV-2	6,1 ohms (approx)
C 40-1	6,0 ohms (approx)

ROUTINE MAINTENANCE

Routine maintenance of the starter solenoid is restricted to an occasional check on the tightness of the terminal nuts and to keeping them, and the surrounding area clean.

No servicing is required or provided for, and where this unit breaks down it must be replaced.

GENERATOR MODELS C 39 PV-2 AND C 40-1

GENERAL

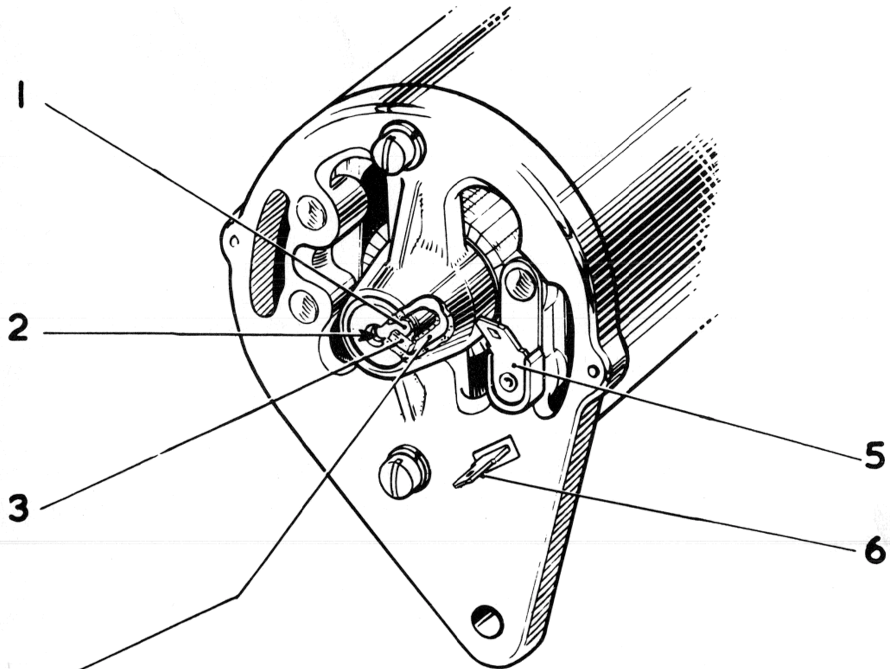
One of two models of generator may be fitted to this engine. They are model C 39 PV-2 and C 40-1.

Except for minor details both generators are identical and are fully interchangeable. The principles of operation, maintenance and overhaul which are described apply equally to both models. The model number may be readily identified by the method of fitting the lucar terminals on the commutator end bracket.

The connectors are secured to the commutator end terminals and field terminal post on generator model C 39 PV-2 with nuts and washers. The connectors on model C 40-1 are integrally constructed.

The generator is a shunt-wound two-pole two-brush machine, arranged to work in conjunction with a compensated voltage control regulator unit.

The output of the generator is controlled by the regulator and is dependent on the state of charge of the battery and the loading of the electrical equipment in use. When the battery is in a low state of charge, the generator gives high output, whereas if the battery is fully charged, the generator gives only sufficient output to keep the battery in good condition without any possibility of over-charging. An increase in output is given to balance the current taken by lamps and other accessories when in use. Further, a high boosting charge is given for a few minutes immediately after starting.



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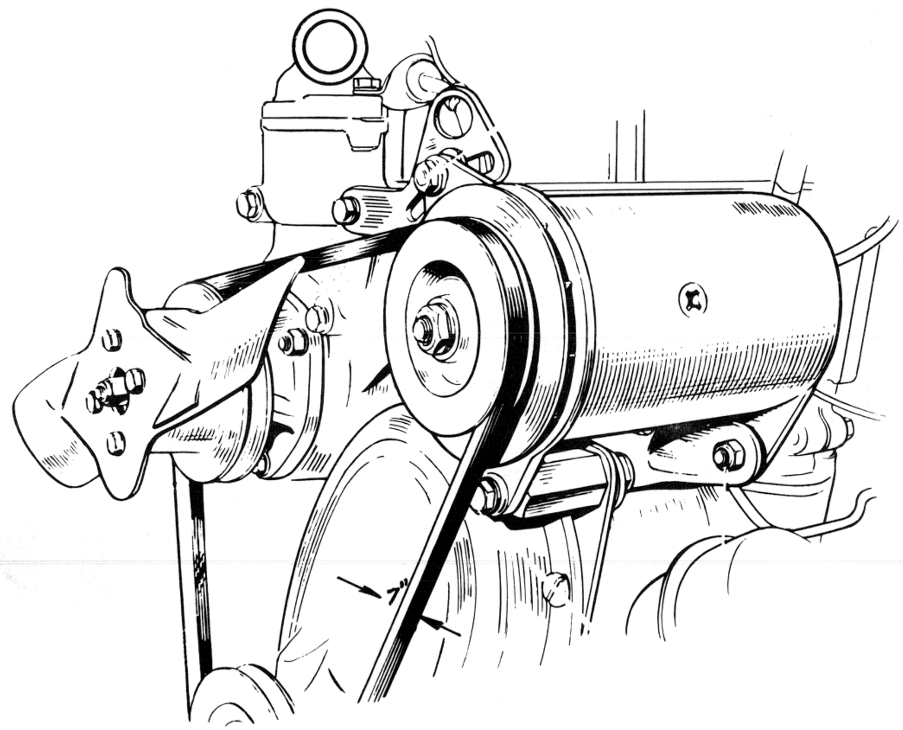

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PERFORMANCE DATA:

Cutting in speed at 13 volts.

C 39 PV-2

V 40-1

1.050 - 1.200 r.p.m.

1.250 - 1.450 r.p.m.

Maximum output at 135 volts

C 39 PV-2

19 amps at 1.900 - 2.150 r.p.m. (connected to a loaded of 0.7 ohms)

Field resistance

C 40-1

6 x 1 ohms (approx)

22 amps at 2.050 - 2.250 r.p.m. (connected to a load of 0.61 ohms)
Field resistance.

6 x 0 ohms (approx)

ROUTINE MAINTENANCE LUBRICATION

Every 12.000 miles, inject a few drops of high quality medium viscosity (S.A.E. 30) engine oil into the hole marked "oil" in the end of the bearing housing, figure 1.

INSPECTION OF BRUSH GEAR AND COMMUTATOR

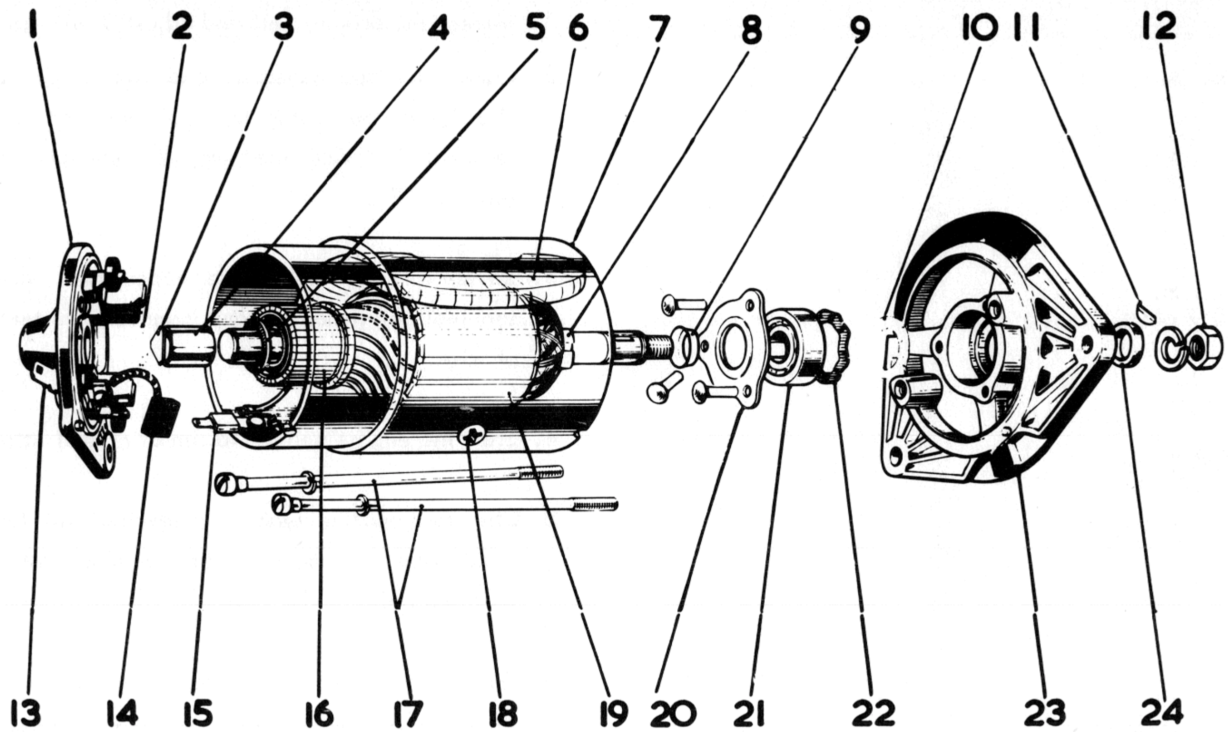
Every 24.000 miles the brush gear and commutator should be inspected by a component automobile electrician.

SERVICING

Testing in position to locate fault in charging circuit. In the event of a fault in the charging circuit, adopt the following procedure to locate the cause of the trouble.

1. Inspect the driving belt and adjust if necessary, figure 2.
2. Check that the generator and control box are connected correctly. The larger generator terminal must be connected to control box terminal "D" and the smaller generator terminal to control box terminal "E".
3. Switch off all lights and accessories, disconnect the cables from terminals of generator and connect two terminals with a short length of wire.
4. Start the engine and set to run at normal idling speed.
5. Clip to negative lead of a moving coil type voltmeter, calibrated 0-20 volts, to one generator terminal and the other lead to a good earthing point of the yoke.
6. Gradually increase the engine speed, when the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts and do not race the engine in an attempt to increase voltage. It is sufficient to run the generator up to a speed of 1.000 r.p.m.

   If the voltage does not rise rapidly and without fluctuation the unit must be dismantled for internal examination.
7. Excessive sparking at the commutator in the above test indicates a defective armature which should be replaced.
8. If the generator is in good order, remove the link from between the terminals and restore the original connections, taking care to connect the larger generator terminal to control box terminal "D" and the smaller generator terminal to control box terminal "F".



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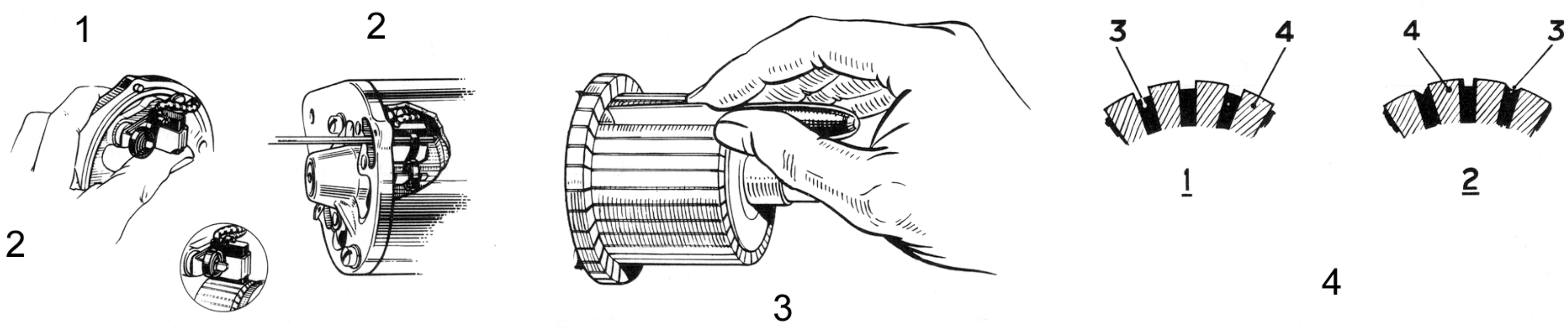

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TO DISMANTLE

1. Take off the driving pulley.
2. Unscrew and withdraw the two through bolts.
3. The commutator end bracket can now be withdrawn from the generator yoke. Take care not to lose the fibre thrust washer.
4. The driving end bracket, which on removal from the yoke has withdrawn with it the armature and armature shaft ball-bearing, need not be separated from the shaft unless the bearing is suspected and requires examination or the armature is to be replaced. In this event the armature should be removed from the end bracket by means of a hand press.

INSPECTION OF COMMUTATOR AND BRUSHGEAR

Every 24.000 miles remove the generator from the engine. Inspect the commutator through the ventilator, which is larger of the two apertures in the end bracket.

The commutator should be clean, free from oil and dirt and have a polished appearance. If it is dirty should be cleaned, through the smaller aperture in the end cover using a soft cloth. This operation will be facilitated if the cloth is wrapped round a piece of hard wood and pressed on the commutator while the armature is revolved by hand. In the event of the commutator being very dirty, the cloth should be moistened with petrol.

Examination of the brush gear is carried out by removing the two through bolts, commutator end bracket and yoke.

Partly lift both brushes and trap them in this raised position with the tension springs, figure 2.

Loosely assemble the end cover to the armature and release the brushes so that they resume their correct position on the commutator.

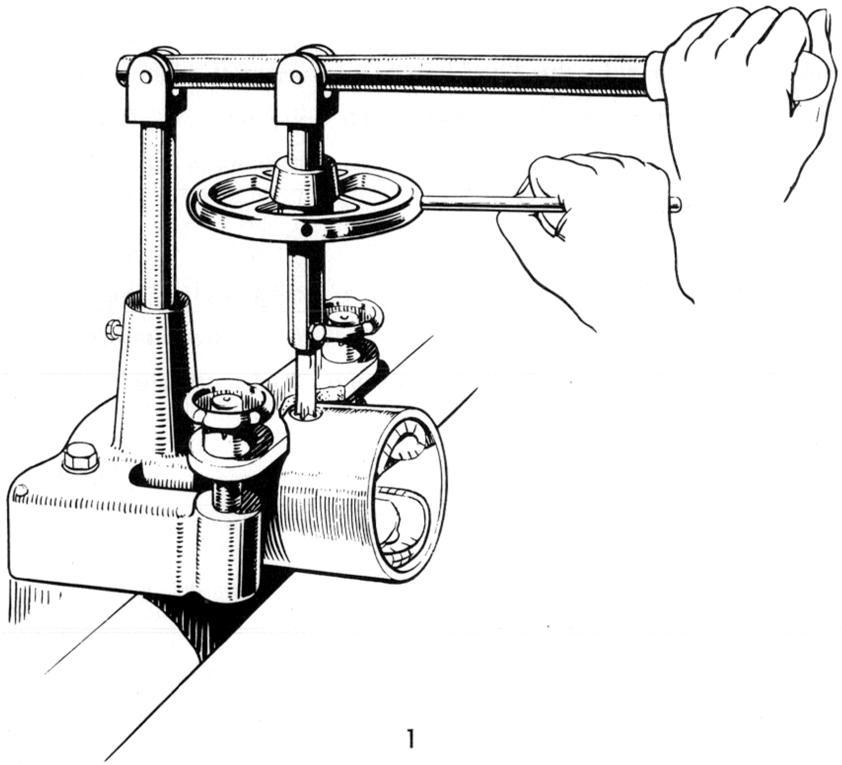
Check that the brushes move freely on the holders, by holding back the tension springs and pulling gently on the flexible connectors. If a brush is inclined to stick, remove it from its holder and clean its sides with a petrol-moistened cloth.

In order to retain the "bedding", brushes must always be replaced in their original position. Brushes which have worn so that they will not "bed" properly on the commutator or have worn to 11/22" (8,5 mm) must be renewed.

Test the brush spring tension using a spring scale. The tension of the spring when new is 22-25 ozs. In service it is permissible for this value to fall to 15 ozs., before performance may be effected. Fit new springs if the tension is low.

COMMUTATOR, FIGURE 3 AND 4

A commutator in good condition will be smooth and free from pits or burned spots. Clean the commutator with a gasoline moistened cloth. If this is ineffective, carefully polish with a strip of fine glass paper while rotating the armature. To remedy a badly worn commutator, mount the armature, with or without the drive end bracket, in a lathe rotate at high speed and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Polish the commutator with very fine glass paper. Undercut the insulators between the segments to a depth of 1/32" (0.8 mm) with a hack saw blade ground to the thickness of the insulator.



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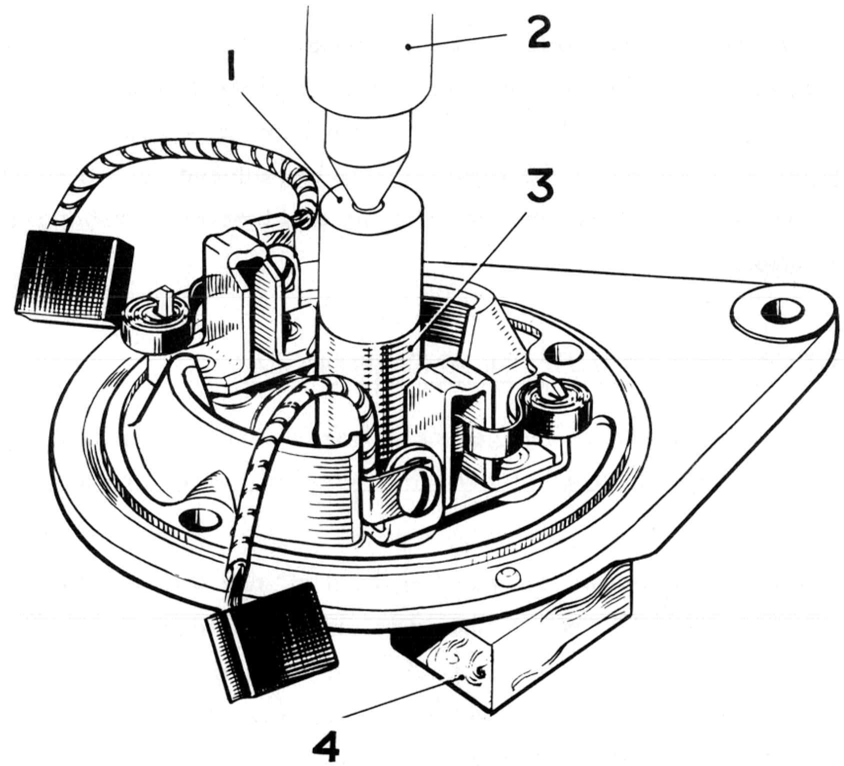

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ARMATURE

Indication of an open circuited armature winding will be given by burnt commutator segments. If armature testing facilities are not available, an armature may be checked by substitution.

To remove the armature shaft from the drive end bracket and bearing, support the bearing retaining plate firmly and press the shaft out the drive end bracket and bearing, support the bearing retaining plate firmly and press the shaft out of the drive end bracket. When fitting the new armature, support the inner journal of the ball bearing, using a mild steel tube of suitable diameter, whilst pressing the armature shaft firmly home.

FIELD COILS

Measure the resistance of the field coils without removing them from the generator yoke, by means of an ohmmeter connected between the field terminal and yoke. If the ohmmeter is not available, connect a 12 volt D.C. supply with an ammeter in series between the field terminal and generator yoke. The ammeter reading should be approximately 2 amperes. Zero reading on the ammeter, or an "infinity" ohmmeter reading, indicates an open circuit in the field winding. Current readings of much more than 2 amperes or ohmmeter readings much below 6.0 ohms are indications that the insulation of one of the field coils has broken down. In either case, unless a substitute generator is available, the field coils must be replaced. To do this, carry out the procedure outlined below.

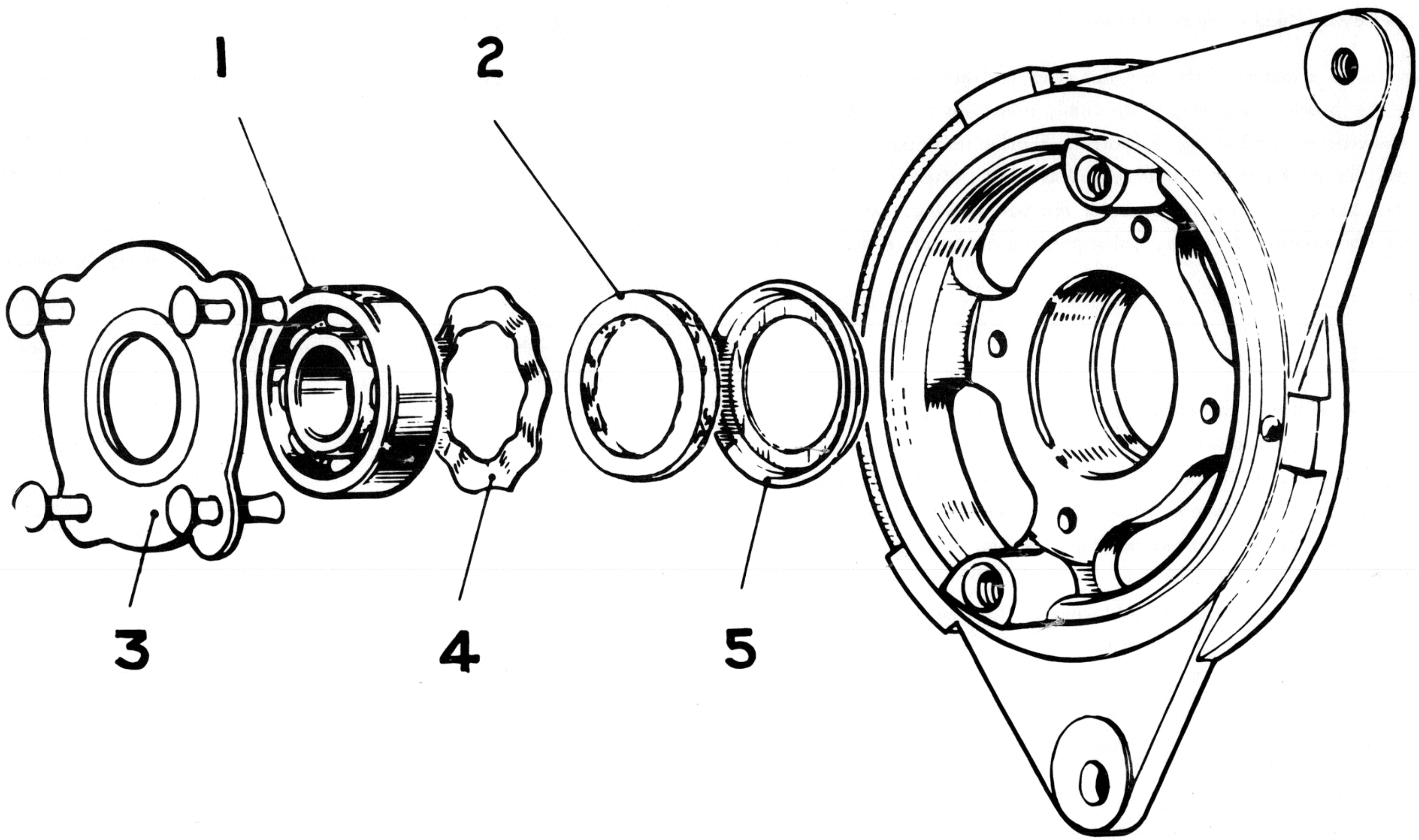
1. Drill out the rivet securing the field coil terminal assembly to the yoke, and unsolder the field coil connection.
2. Remove the insulation piece which is provided to prevent the junction of the field coils from contacting with the yoke.
3. Mark the yoke and pole shoes so that the latter can be fitted in their original positions.
4. Unscrew the two pole shoes retaining screw by means of a wheel operated screwdriver, figure 1.
5. Draw the pole shoes and coils out of the yoke and lift off the coils.
6. Fit the new field coils over the pole shoes and place them in position inside the yoke. Take care to ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.
7. Locate the pole shoes and field coils by lightly tightening the fixing screw.
8. Fully tighten the screw by means of the wheel-operated screwdriver and lock them by caulking.
9. Replace the insulation piece between the field coil connections and the yoke.
10. Re-solder the field coil connections to the field coil terminal tags and rivet the assembly to the yoke.

BEARINGS

Bearings which have worn to such an extent that they will allow side movement of the armature shaft must be replaced.

To replace the bearing bushing in a commutator end bracket, proceed as follows:

Remove the old bearing bushings from the end bracket, this can be done by screwing a 5/8" tap into the bushing for a few turns and pulling out the bushing with the tap, screw the tap squarely into the bushing to avoid damage to the bracket.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Insert the felt ring and aluminum disc in the bearing housing, then press the new bearing bushing into the end bracket (using a shouldered, highly polished mandrel of the same diameter as the shaft which is to fit in the bearing) until the bearing is flush with the inner face of the bracket.

NOTE: Porous bronze bushing must not be opened out after fitting, or the porosity of the bushing may be impaired. Before fitting the new bearing bushing it should be allowed to stand for 24 hours completely immersed in thin engine oil, this will allow the pores of the bushing to be filled with lubricate.

The ball bearing at the driving end is replaced as follows: Figure 1.

1. Drill out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.
2. Press the bearing out of the end bracket and remove the corrugated washer, felt washer and oil retaining washer.
3. Before fitting the replacement bearing see that it is clean and pack it with high melting point grease.
4. Place the oil retaining washer, felt washer and corrugated washer in the bearing housing in the end bracket.
5. Locate the bearing in the housing and press it home.
6. Fit the bearing retaining plate. Insert the new rivets from the inside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

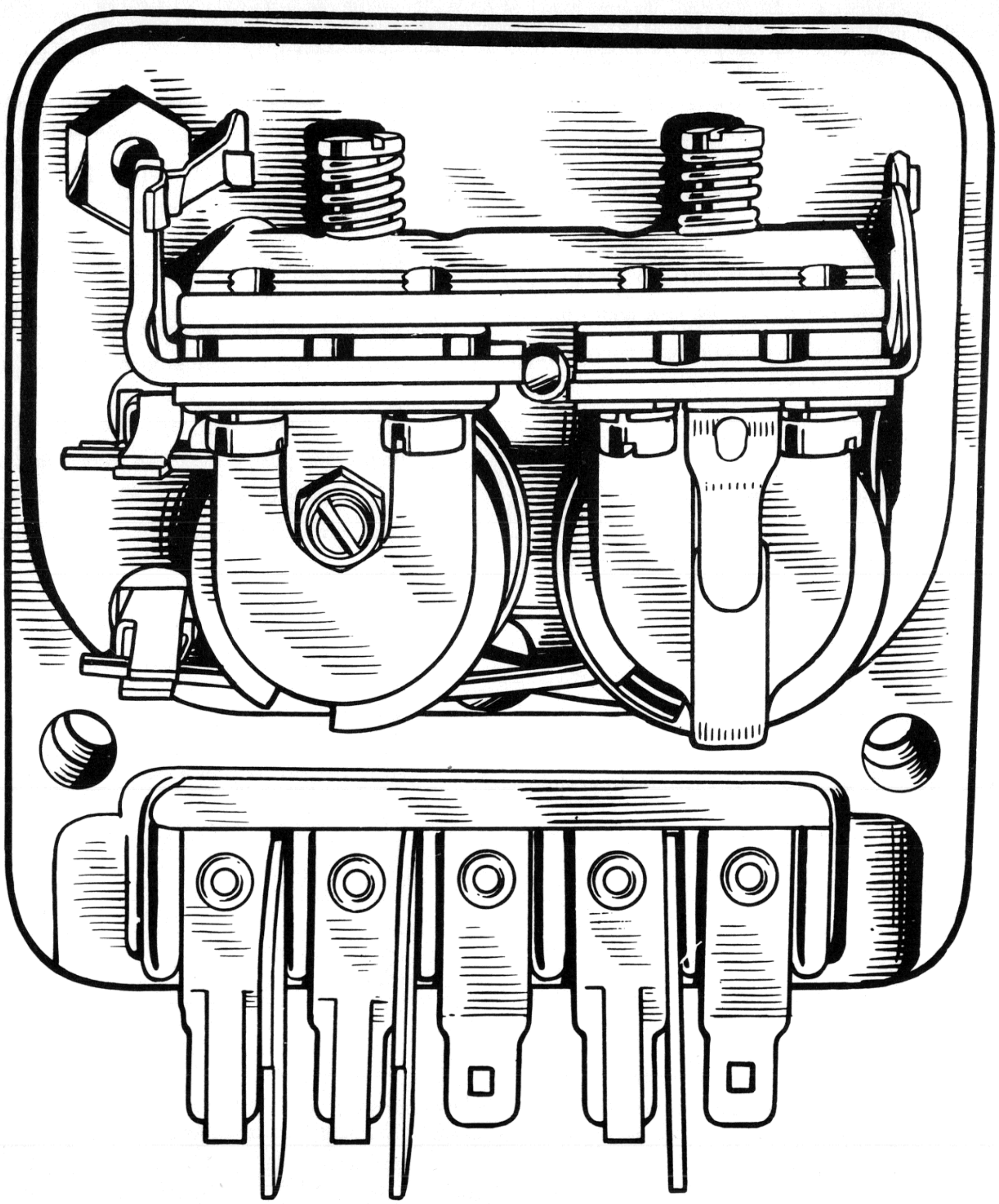
RE-ASSEMBLY

1. Fit the drive end bracket to the armature shaft. The inner journal of the bearing must be supported by a tube, approximately 4" long, 1/8" thick, and internal diameter 5/8". Do not use the drive end bracket as a support for the bearing whilst fitting an armature.
2. Fit the yoke to the drive end bracket.
3. Lift the brushes up into the brush boxes and secure them in that position by positioning each brush spring at the side of its brush.
4. Fit the commutator end bracket on the armature shaft until brush boxes are partly over the commutator. Place a thin screwdriver on top of each brush in turn and press the brush down on the commutator. The brush springs should then position themselves on top of the brushes.
5. Fit the commutator end bracket to the yoke so that the projection on the bracket locates in the yoke.
6. Refit the two through bolts.

   After re-assembly lubricate the commutator end bearing.

CONTROL BOX

Model	R. B. 106/2
Cut-out	Cut in voltage 12.7 to 13.3,
	Drop off voltage 8.5 to 11
	Reverse current 3.5 to 5 amps.
Regulator	Open circuit settings at 3.000 r.p.m. at ambient temperature.



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CONTROL BOX MODEL RB 106-2

The control box contains two units, a voltage regulator and a cut-out. Although combined structurally, the regulator and cut-out are electrically separate. Both are accurately adjusted during manufacture, and the cover protecting them should not be removed unnecessarily.

REGULATOR

The regulator is set to maintain the generator terminal voltage between close limits at all speeds above the regulating point, the field strength being controlled by the automatic insertion and withdrawal of a resistor in the generator field circuit. When the generator voltage reaches predetermined value, the magnetic flux in the regulator care due to the shunt or voltage winding becomes sufficiently strong to attract the armature to the care. This causes the contacts to open, thereby inserting the resistor in the generator field circuit.

The consequent reduction in the generator field current lowers the generator terminal voltage and this in turn, weakens the magnetic flux in the regulator core. The armature, therefore, returns to its original position, and the contacts closing allow the generator voltage to rise again to its maximum value.

The cycle is then repeated, and an oscillation of the armature is maintained. As the speed of the generator rises above that at which the regulator comes into operation, the periods of contact separation increase in length and, as a result, the generator voltage undergoes little change once this regulating speed has been attained.

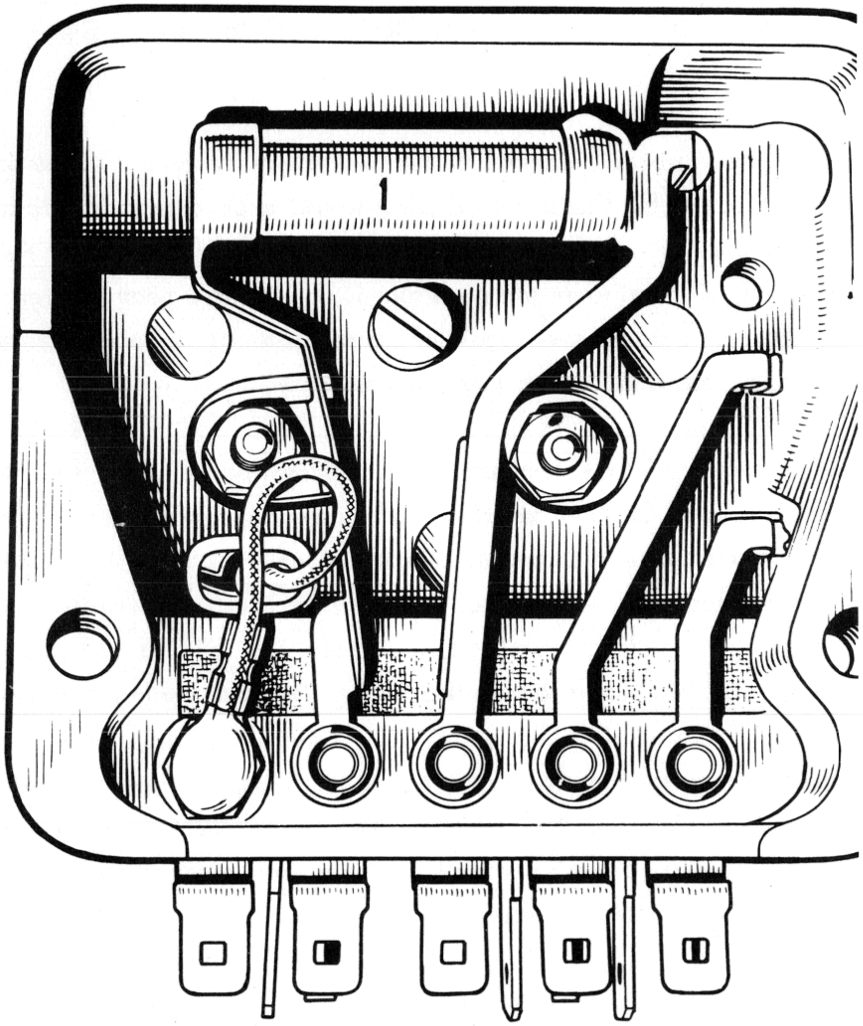
The series or current winding provides a compensation on this system of control. If the control were arranged entirely on this basis of voltage there would be a risk of overloading the generator when the battery was in a low state of charge, particularly if the lamps were simultaneously in use.

Under condition of reduced battery voltage, the output to the battery rises and but for the series winding would exceed normal rating of the generator. The magnetism due to the series winding assists the shunt winding, so that when the generator is delivering a heavy current into a discharged battery the regulator comes into at a somewhat reduced voltage, thus limiting the output accordingly.

By means of a temperature compensating device the voltage characteristic of the generator is caused to conform more closely to that of the battery under all climatic conditions. If cold weather, the voltage required to charge the battery increases, whilst in warm weather the voltage required is lower. The method of compensation takes the form of a bimetallic spring located behind the tensioning spring of the regulator armature. This bimetallic spring, by causing the operating voltage of the regulator to be increased in cold weather and reduced in hot weather, compensates for the changing temperature characteristics of the battery and prevents undue variation of the charging current which would otherwise occur.

The bimetallic spring also compensates for effects due to increases in resistance of the copper windings from cold to working values.

The cut-out is an electro-magnetically operated switch connected in the charging circuit between the generator and the battery.



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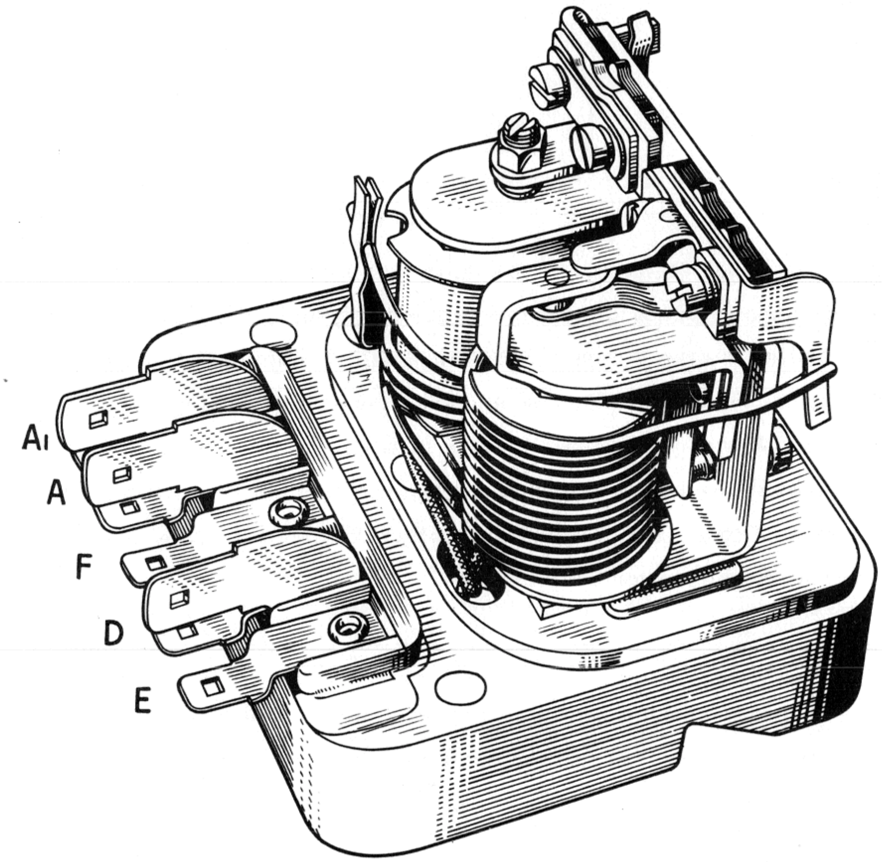

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Its function is to connect the generator with the battery when the voltage of the generator is sufficient to charge the battery, and to disconnect it when the generator is not running, or when its voltage falls below that of the battery, and so prevents the battery from discharging through and possibly damaging the generator windings.

The cut-out consists of an electro-magnetic fitted with an armature which operates a pair of contacts. The electromagnet employs two windings, a shunt winding of many turns of fine wire, and a series winding of a few turns of heavier gauge wire. The contacts are normally held open, and are closed only when the magnetic pull of the magnet on the armature is sufficient to overcome the tension of the adjusting spring.

OPERATION OF THE CUT-OUT IS AS FOLLOW, FIGURE 1 AND 2

The shunt coil is connected across the generator. When the vehicle is starting, the speed of the engine and thus the voltage of the generator, rises until the electromagnetic is sufficiently magnetized to overcome the spring tension and close the cut-out contacts.

This completes the circuit between the generator and the battery through the series winding of the cut-out and the contacts. The effect of the charging current flowing through the series windings creates a magnetic field in the same direction as that produced by the shunt-winding. This increases the magnetic pull on the armature so that the contacts are firmly closed, and cannot be separated by vibration. When the vehicle is stopping, the speed of the generator falls until the generator voltage is lower than that of the battery.

Current then flows from the battery through the cut-out series winding to generator in a reverse direction to the charging current. This reverse current through the cut-out will produce a differential action between the two windings and partly de-magnetize the electro-magnet. The spring, which under constant tension, then pulls the armature away from the magnet and so separates the contacts and opens the circuit.

Like the regulator operation of the cut-out is temperature-controlled by means of a bi-metallic tensioning spring.

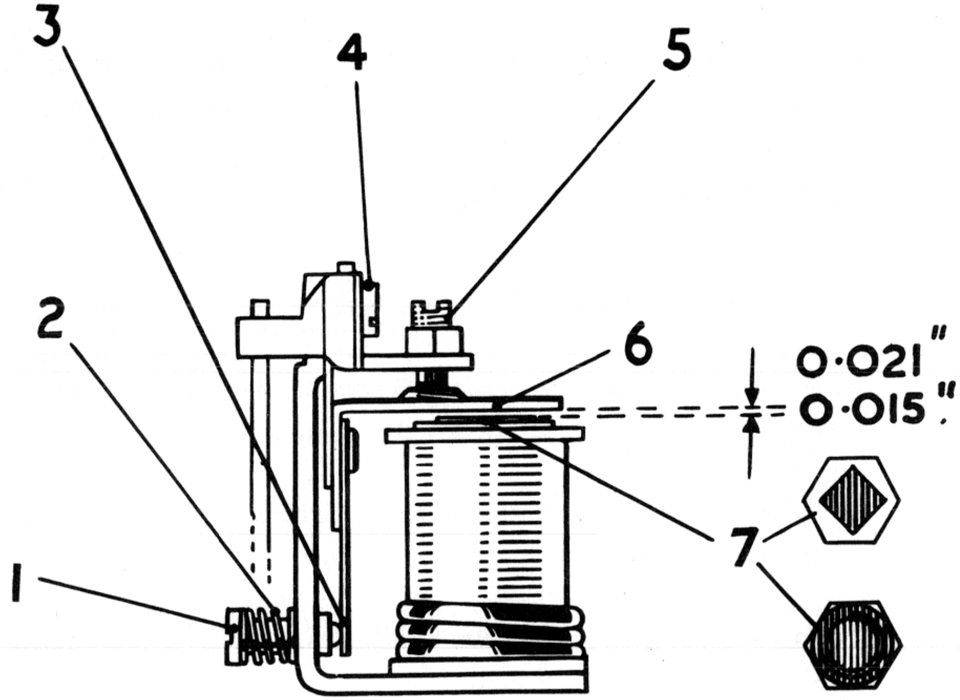
SETTING-DATA

All settings are accurately adjusted before control boxes leave the factory and must not be disturbed unnecessarily. Any subsequent attention which may be required should only be carried out by a qualified automobile electrician.

A) PRELIMINARY CHECKING OF CHARGING CIRCUIT

Before disturbing any electrical adjustment, examine as follows to ensure that the fault does not lie outside the control box.

1. Check the battery by substitution or with any hydrometer and a heavy discharge tester.
2. Inspect the generator driving belt. This should be just tight enough to drive without undue tension.
3. Check the generator by substitution or by disconnecting the generator cables and linking large terminal "D" to small terminal "F", then connect a voltmeter between this link and earth and run the generator up to about 1.000 r.p.m. when a rising voltage should be shown.
4. Inspect the wiring of the charging circuit and carry out continuity tests.
5. Check earth connections, particularly those of the control box.



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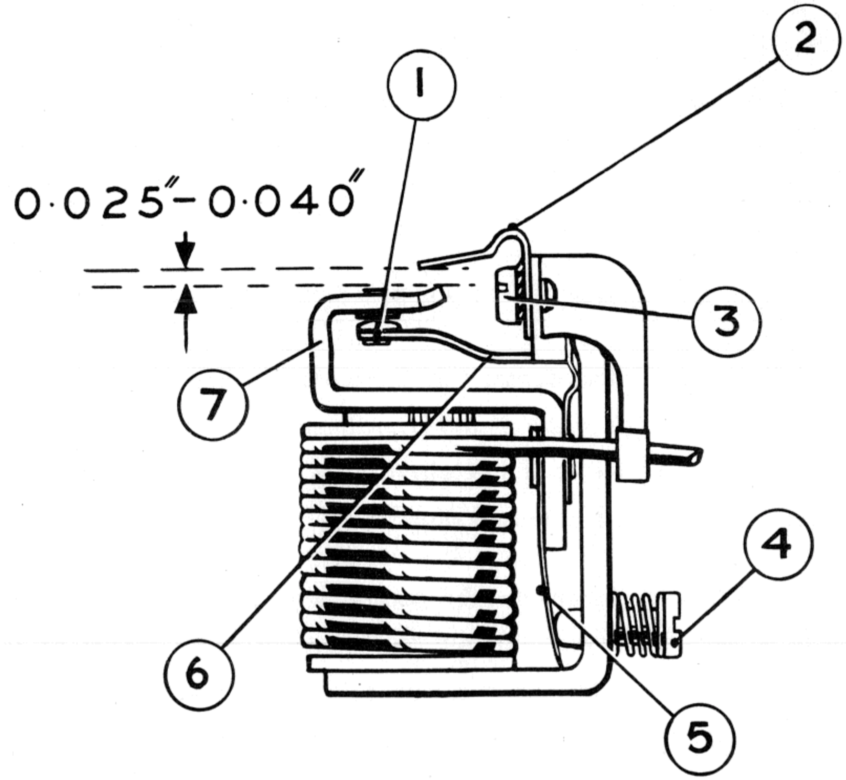

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6. In the event of reported undercharging, ascertain that this is not due to low mileage.

CHECKING REGULATOR ELECTRICAL SETTING

Checking and adjusting should be completed as rapidly as possible to avoid errors due to heating of the shunt coil.

1. Connect a first-grade 0.20 moving coil voltmeter between control box terminals "D" and "E".
2. Withdraw the connectors from terminals "A" and "A 1", and join the two longer connectors together temporarily, thereby proving a supply from the battery to the ignition system. Take care that these connectors are not allowed to make contact with the car body.
3. Start the engine and run the generator at approx. 3.000 r.p.m. The voltmeter reading should now lie between the appropriate limits, as follows:

Ambient temperature	Open-circuit voltage
10º C (50º F)	16.1 - 16.7
20º C (68º F)	16.0 - 16.6
30º C (86º F)	15.0 - 16.5
40º C (104º F)	15.8 - 16.4

An unsteady reading may be due to unclean contacts but if the reading is outside the appropriate limits, an adjustment must be made.

4. Stop the engine.

C) REGULATOR ELECTRICAL ADJUSTMENT, FIGURE I AND 2

1. Remove the control box cover.
2. Restart the engine and run the generator at 3.000 r.p.m.
3. Turn the spring-loaded adjustment screw (clockwise to raise the setting or anti-clockwise to lower it) until the correct setting is obtained.
4. Check the setting by stopping the engine and then again raising the generator speed to 3.000 r.p.m.
5. Restore the original connections and refit the control box cover.

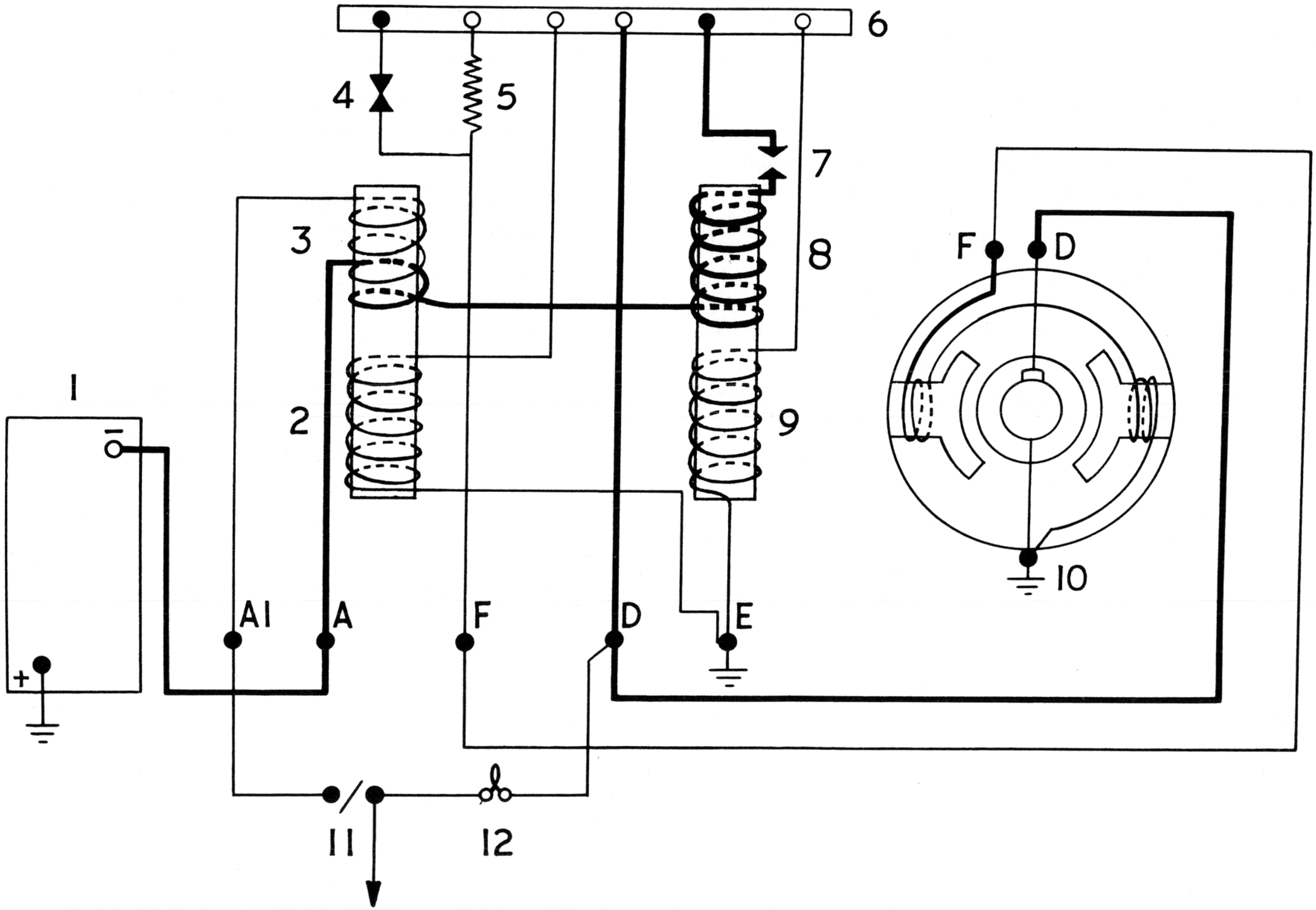
D) CHECKING CUT-OUT RELAY ELECTRICAL SETTING

Checking and adjustment should be completed as rapidly as possible to avoid errors due to heating of the shunt coil.

1. Connect a first-grade 0.20 moving coil-voltmeter between control box terminal "D" and "E".
2. Remove the control box cover in order to note the instant of contact closure.

   Alternatively, switch on an electrical load such as a pair of headlamps, when the instant of contact closure will be indicated by a slight flick in the voltmeter reading.
3. Start the engine and slowly increase its speed.
4. Observe the voltmeter pointer.

   If contacts closure or a flick of the pointer occurs outside the limits 12 x 7 - 13 x 3 volts, an adjustment must be made.
5. Stop the engine.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E) CUT-OUT RE LAY ELECTRICAL ADJUSTMENTS

1. Method of cut-in voltage adjustment.

   Remove the control box cover.

   Turn the cut-out relay adjustment screw (clockwise to raise the setting or anti-clockwise to lower it) until the correct setting is obtained. Re-check the setting by again increasing the engine speed from zero.

2. Method of drop-off adjustment.

   Withdraw the connectors from terminals "A" and "A 1", and join the two larger connectors together temporarily. Connect a first-grade 0.20 moving coil voltmeter between terminal "A" and "A 1" on earth.

   Start the engine and run up to speed. Slowly decelerate and observe the voltmeter pointer.

   Opening the contacts, indicated by the voltmeter pointer dropping to zero, should occur between the limits 8 x 5 - 11 x 0 volts, if the drop-off occurs outside these limits, an adjustment must be made. In this event, continue as follows:

   Stop the engine and remove the control box cover. Adjust the height of the fixed contact by carefully bending the fixed contact blade towards the bobbin to reduce the drop-off voltage or away from it to raise the drop-off voltage.

   Re-check the setting and, if necessary, re-adjust until the correct drop-off setting is obtained.

   Restore the original connections and refit the cover.

F) CLEANING CONTACTS

1. Regulator contacts.

   To clean the voltage regulator contacts, use fine carborundum stone on sillion carbide paper.

2. Cut-out relay contacts.

   To clean the cut-out relay contacts, use a strip of fine glass paper - never carborundum stone or emery cloth.

Circuit diagram of generating system, Figure 1.

BENCH SETTING OF AIR GAPS

1. VOLTAGE REGULATOR

With the armature in the free position and correctly set, the distance between the core face and the underside of the armature is 0 x 030" of which 0 x 015" is through air when the copper separator consists of a disc. And 0 x 021" when a square of copper is used.

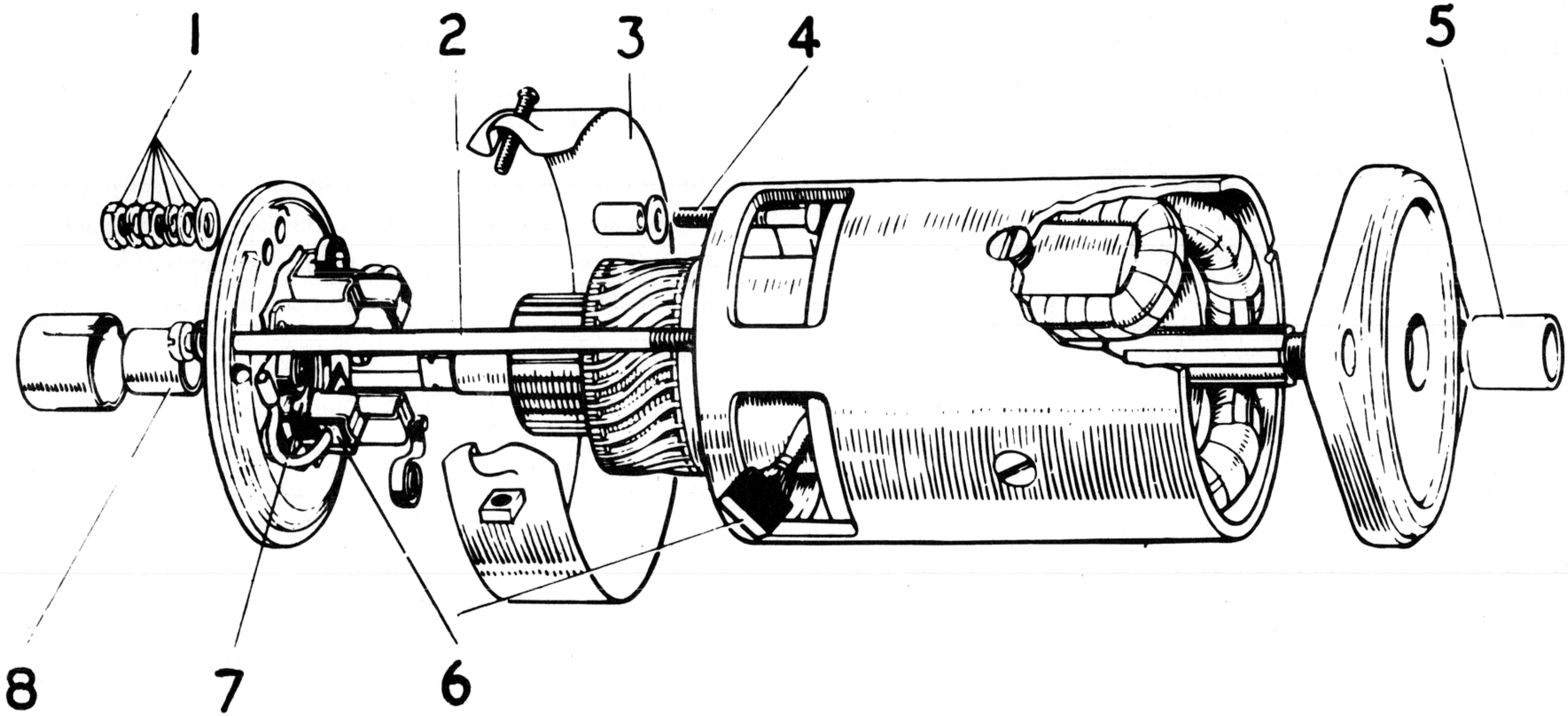
To obtain this air gap proceed as follows:

Slacken the fixed contact locking nut and unscrew the contact screw until it is well clear of the armature moving contact.

Slacken the voltage adjustment spring-loaded screw until it is well clear of the armature tension spring.

Slacken the two armature assembly securing screws. Insert a 0 x 015" gauge (when a copper disc separator is fitted) or a 0 x 021" gauge (when a square copper separator is used) between the armature and copper separator. The gauge must be wide enough to cover completely the core face. Take care not to pry up the copper separation when inserting the gauge.

Press the armature squarely down against the gauge and retighten the two armature assembly securing screws. Without removing the gauge, screw in the fixed contact adjustment screw until it just touches the armature contact. Retighten the locking nut.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Re-adjust the electrical setting of the regulator.

2. CUT-OUT RELAY

Slacken the adjustment screw until it is well clear of the armature tension spring.

Slacken the two armature securing screws.

Press the armature squarely down against the core face (copper sprayed in some units, fitted with a square of copper in others) and retighten the armature securing screws. No gauge is necessary.

With the armature still pressed against the core face and, using suitable pliers, adjust the gap between the armature stop arm and the armature tongue to 0 x 025" - 0 x 040" by carefully bending the stop arm.

Adjust the fixed contact so that it will be deflected from between 0 x 010" - 0 x 020" by the armature moving contact when the armature is pressed against the core face.

Re-adjust the electrical setting of the cut-out.

STARTER MOTOR MODEL M 35 G (INBOARD DRIVE)

GENERAL, FIGURE 1

The electric starter motor is a series-parallel wound four-pole four-brush machine having an extended shaft which carries the engine engagement gear, or starter drive that is more usually named. The diameter of the yoke is 3 x 5".

The starter motor is of similar construction to the generator except the heavier copper wire is used in the construction of the armature and field coils. The field coils are parallel-connected between the field terminal and the insulated pair of brushes.

The only maintenance normally required is the occasional checking of brushgear and commutator.

Approx. every 24.000 miles, remove the metal band cover. Check that the brushes move freely in their holders by holding back the brush springs and pulling very gently on the flexible connectors. Should a brush incline to stick, remove it from its holder and clean its sides with a petrol moistened cloth. Be sure when refitting the brushes that they return to their original positions in order to retain the "bedding". If the brushes have worn to 5/16" in length then these must be replaced.

The commutator should also be cleaned free from oil or dirt. If dirty, clean by pressing a fine dry cloth against it while the starter is turned by hand by means of a wrench applied to the squared extension of the shaft.

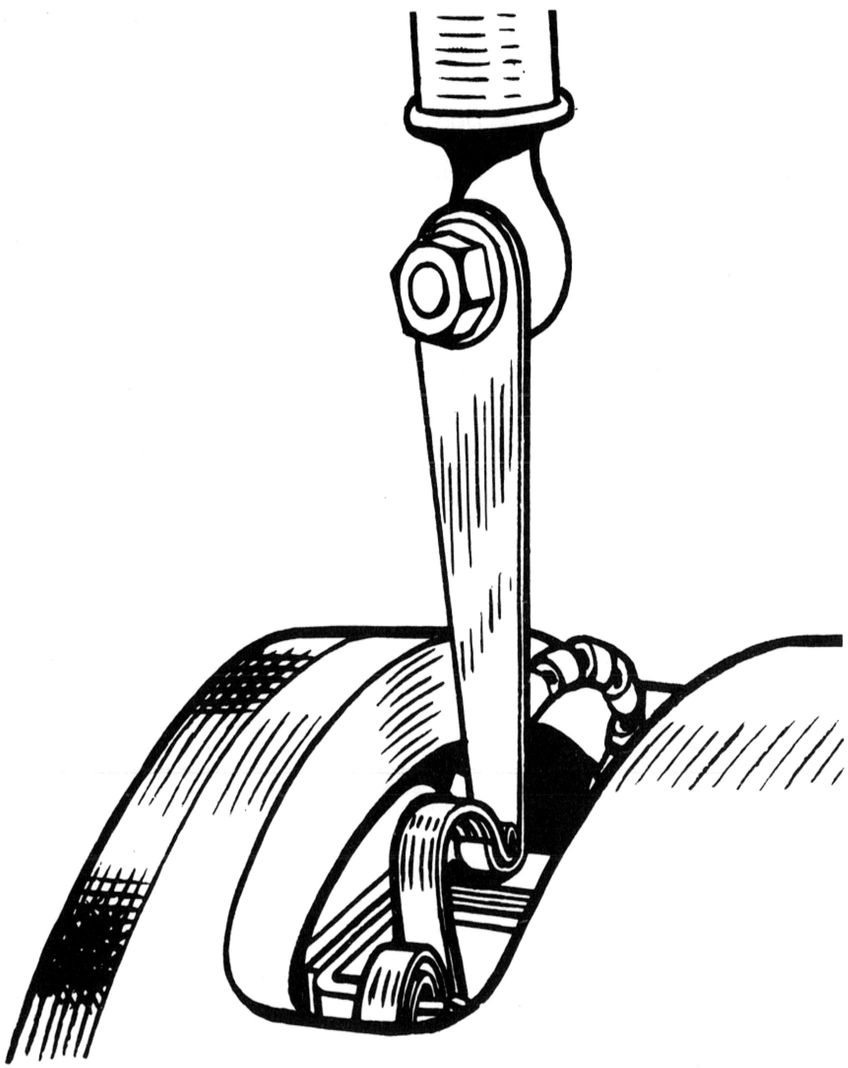
PERFORMANCE DATA

Lock torque 7 x 2 lb/ft. with 320 - 340 amps, at 7 x 25 - 7 x 5 volts.

Torque at 1.000 r.p.m. 4 x 4 -4 x 6 lb/ft. with 230 -250 amps, at 8 x 25 - 8 x 45 volts. Light running current: 80 amps, maximum at 7.000 -8.000 r.p.m.

SERVICING-TESTING IN POSITION

1. Switch on the lamps and operate the starter control. If the lights go dim, but the starter motor is not heard to operate, an indication is given that current is flowing through the starter motor windings but that the armature is not rotating for some reason, possibly the pinion is meshed permanently with the geared ring on the flywheel. In this case, the starter motor must be removed from the engine for examination.



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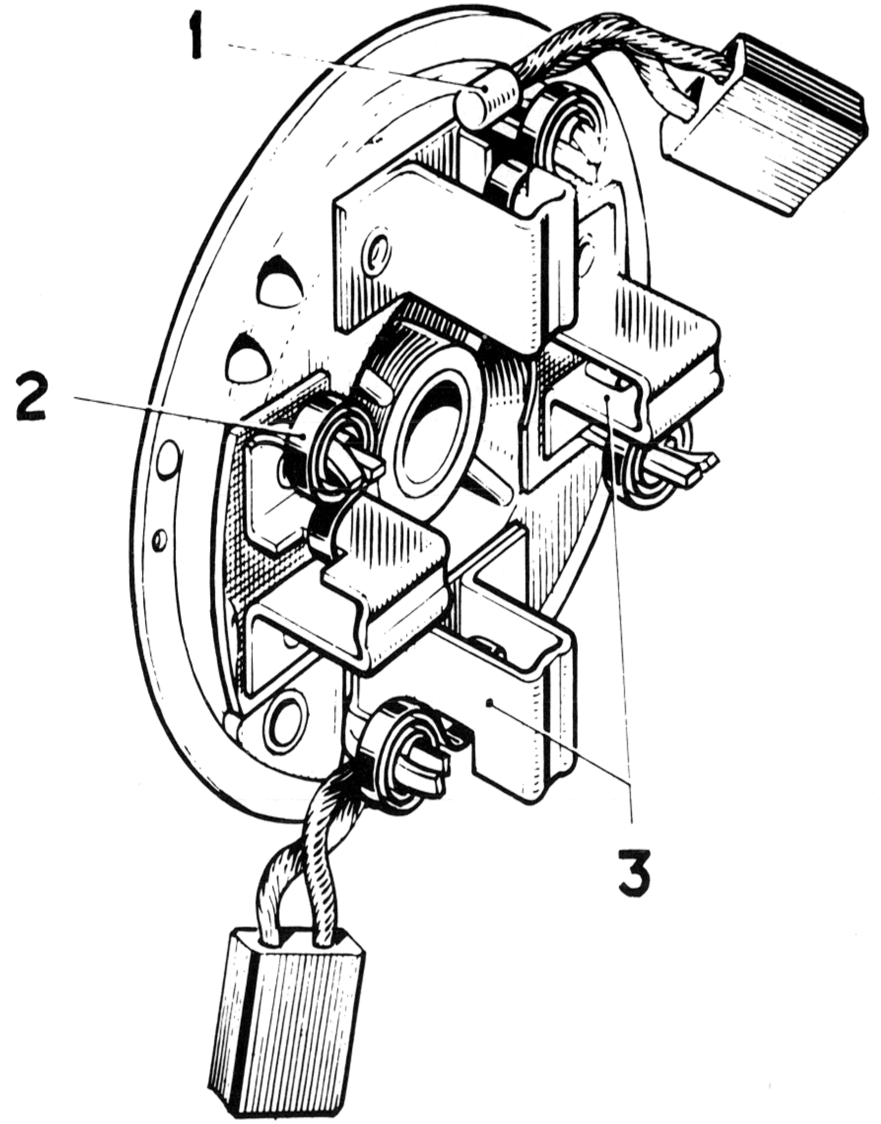

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In this event, a variable resister of suitable current-carrying capacity should be connected in the battery circuit and adjusted until the lock voltage is the same as that quoted. Take readings of current and torque at this value.

3. FAULT DIAGNOSIS

An indication of the nature of the fault or faults may be deduced from the results of the no-load and lock torque tests.

DISMANTLING

Remove the cover band, hold back the brush springs and lift the brushes from their holders.

Unscrew the terminal nuts from the terminal post on the commutator end bracket.

Unscrew the two through bolts from the commutator end bracket, and remove the commutator end bracket from the yoke.

Remove the driving end bracket complete with armature and drive from the starting motor yoke.

BENCH INSPECTION

After the motor has been dismantled, individual items must be examined as follows:

BRUSHGEAR

When necessary, the brushes and brush-holders must be cleaned using a clean, fluff less petrol-moistened cloth.

To prevent damage to the commutator, brushes must be replaced when worn to 5/16" in length.

(Figure 1 Testing brush spring tension)

(Figure 2 Commutator end bracket brush connections)

To fit new brushes proceed as follows:

1. Cut off the original brush flexible 1/8" (3 mm approx.) from the aluminum.
2. Clean up and tin the original resistance-brazed joint.
3. Open out the loop of the replacement brush flexibles.
4. Tin the loop, taking great care not to allow any solder to run towards the brush.
5. Plate the original joint within the loop.
6. Squeeze up and solder.

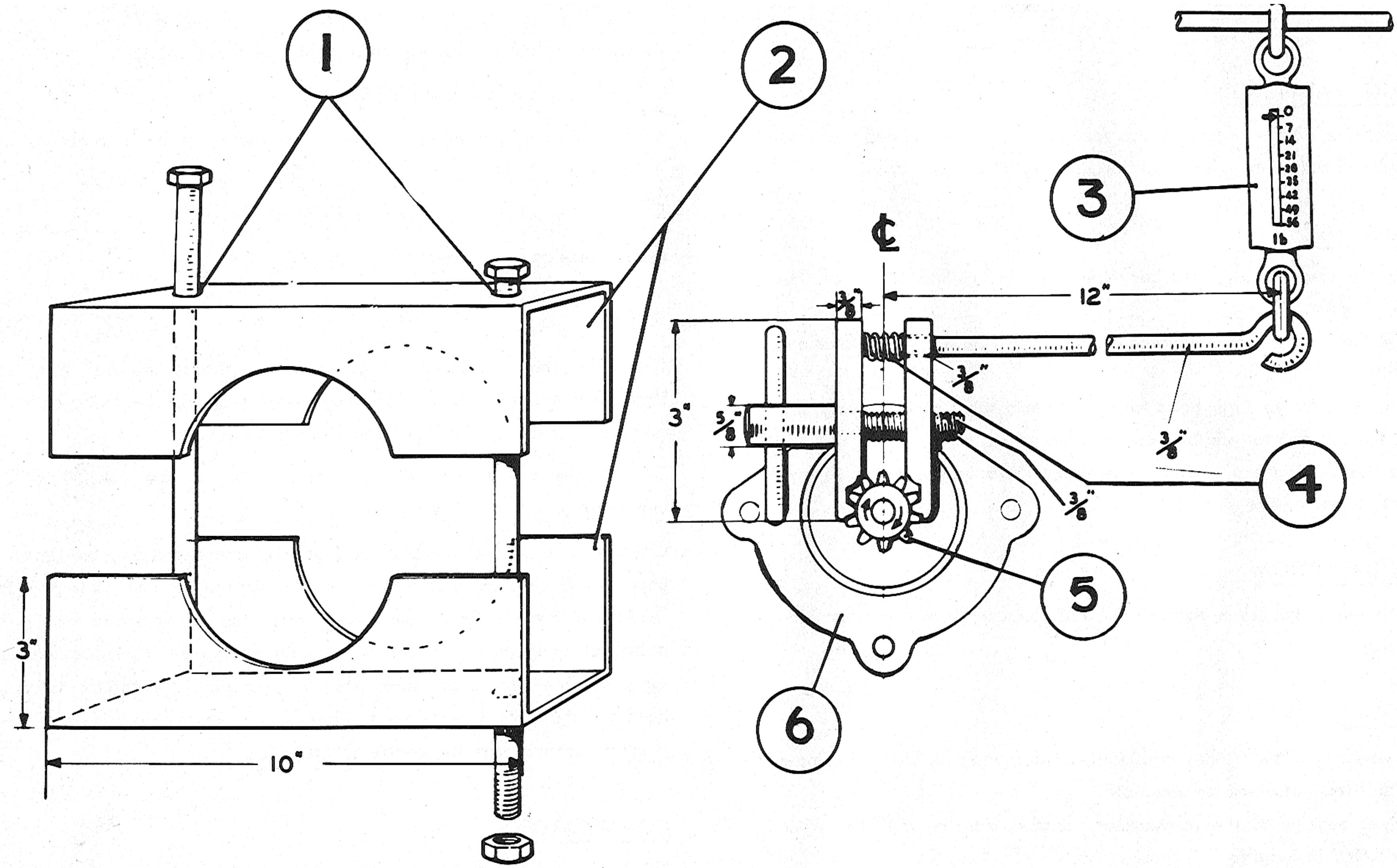
NOTE: Providing the necessary equipment is available for refitting and tightening the pole shoes, the above operating will be found easier to carry out if the field coils are removed from the yoke.

The brushes are pre-formed so that bedding to the commutator is unnecessary.

Check the tension of the brush springs using a spring scale, see figure 1, page 1/120. The correct tension is 32 - 40 oz. Fit new springs if the tension is low. To fit a new spring, open the spring anchor slot in the brush spring support post and lift the old spring away. Place the new spring in the slot in the same position as occupied by the old spring. Re-close the slot. Check the tension of the new spring and ensure that it makes contact with the centre of the brush.

COMMUTATOR

The commutator must be clean and have a polished appearance. If it is dirty it must be cleaned, using a clean fluff less gasoline-moistened cloth or, if necessary, by polishing it with a strip of very fine emery cloth.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STARTER MOTOR

Model	M 35 G
4 brush 4 pole	Series parallel
Rotation	Clockwise
Drive	S.B. inboard
Brush spring tension	23 to 40 ozs.
Lock torque	72 to 7.6 lbs. with 320 to amps at 7.5 to 7.25 volts
Torque at 1.000 r.p.m	4.4 to 4.6 with 230 to 250 amps at 8.45 to 8.25 volts
Light running current	80 amps maximum at 7,000 to 8.000 r.p.m.
Brushes	Change brushes when worn to 5/16" (8 mm) in length.

2. Should the lamps retain their full brilliance when the starter switch is operated, check the circuit for continuity from battery to starter motor via the starter switch and solenoid and examine the connections at these units. If the supply voltage is found to be applied to the starter motor when the switch is operated an internal fault in the motor is indicated and the unit must be removed from the engine for examination.
3. Sluggish or slow action of the starter motor is usually due to a loose connection causing high resistance in the motor circuit. Check as described previously.
4. If the motor is heard to operate, but does not crank the engine, indication is given of damage to the drive.

BENCH TESTING

1. Removing the starter motor from the engine.

Disconnect the earth terminal on the battery to avoid any danger of short circuits. Remove the heavy cable from the starter motor. Withdraw the mounting bolts and remove the starter motor from the engine.

2. MEASURING THE LIGHT RUNNING CURRENT

Secure the starter motor in a vice.

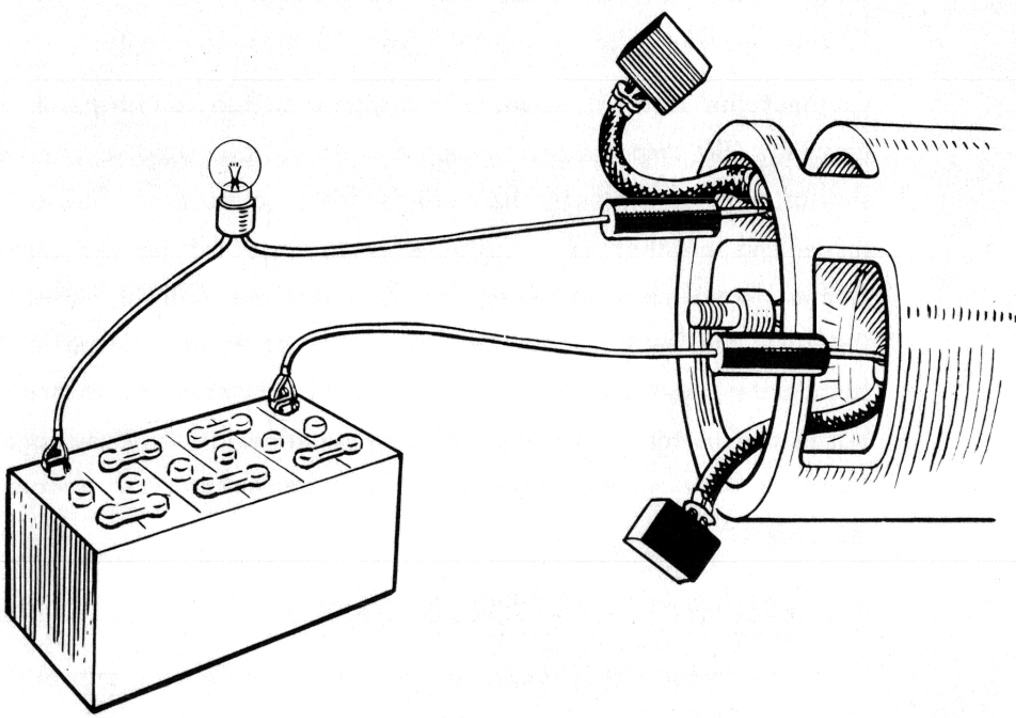
Connect the motor in series with a starter switch, an ammeter capable of carrying 600 amperes and an appropriate voltage supply. Use cables of a similar size to those in the vehicle motor circuit. A fixing lug on the drive end bracket is a suitable earthing point on the starter motor. Connect a voltmeter between the motor terminal and the yoke.

Operate the switch and note the speed of armature rotation, using a tachometer, and the readings given by the ammeter and voltmeter. While the motor is running at speed examine the brush gear and check if there is any undue sparking at the commutator or excessive brush movement.

2. MEASURING LOCK TORQUE AND LOCK CURRENT, FIGURE 1

With the motor firmly clamped in a vice, attach an arm to the driving pinion, connect the free end of this arm to a spring scale. Operate the switch and note the current consumption, voltage, and the reading on the spring scale, the measure of torque can be calculated by multiplying the reading on the spring scale in pounds by the length of the arm in feet.

If a constant-voltage bus-bar supply is used when carrying out the lock torque test, a higher lock voltage may be shown on the voltmeter than the appropriate value given under performance data.



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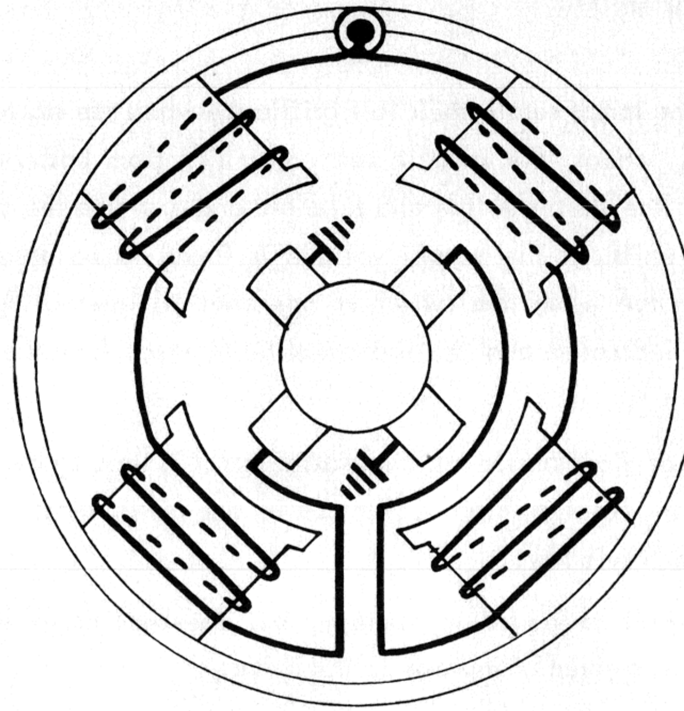

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To remedy a badly worn commutator/dismantle the starter drive and remove the armature from the end bracket. Mount the armature in a lathe, rotate at a high speed and take a light cut with a very sharp tool.

Do not remove any more metal than is necessary. Finally, polish with a very fine glass paper. The INSULATORS between the commutator segments MUST NOT BE UNDERCUT.

ARMATURE

Check for lifted commutator segments and loose turns in the armature winding. These may be due to the starter motor having remained engaged while the engine is running, thus causing the armature to be rotated at excessive speed.

A damaged armature must always be replaced -no attempt should be made to machine the armature core or to true a distorted armature shaft. An indication of a bent shaft or a loose pole shoe may be given by scored armature laminations.

To check armature insulation, use an ohmmeter or a 110 volt a.c. test lamp. A high reading should be shown on the meter when connected between the armature shaft and the commutator segments. If a test lamp is used, it must not light when connected as above. Faulty insulation will be indicated by a low reading or by lighting of the test lamp.

If a short circuit is suspected, check the armature on a "growler". The motor overheating may cause blobs of solder to short circuit the commutator segments.

If an armature fault cannot be located and remedied, a replacement armature must be fitted.

FIELD COILS

Continuity test:

Connect a battery and suitable bulb in series with two pointed probes, figure 1.

If the lamp fails to light in the following test an open circuit in the field coils is indicated and the defective coils must be replaced. Place one probe at the terminal post and the other at each brush tapping in turn. The bulb should light.

Lighting of the lamp does not necessarily indicate that the field coils are in order. It is possible that a field coil may be earthed to a pole shoe or to the yoke.

(Figure 2 Circuit diagram of internal connections).

Insulation test:

Connect an ohmmeter or a 110 volt a.c. test lamp between the terminal post and a clean part of the yoke. lighting of the test lamp or a low ohmmeter reading indicates that the field coils are earthed to the yoke and must be replaced.

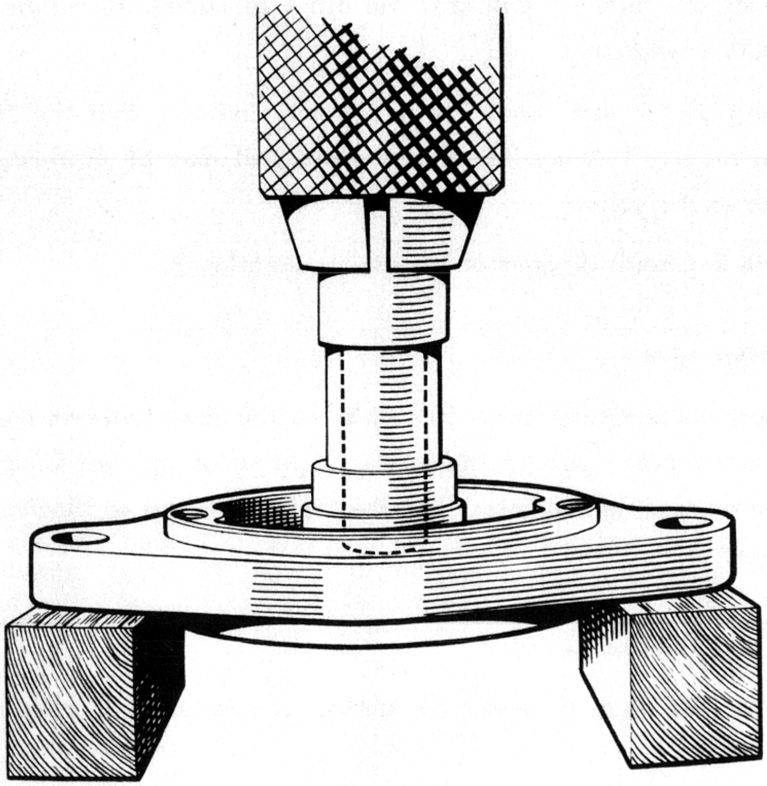
Replacing the fuel coils:

Unscrew the four pole-shoe retaining screws using a wheel-operated screwdriver.

Remove the insulation piece, which is fitted to prevent the inter-coil connectors from contacting with the yoke. Mark the yoke and pole shoes in order that they may be refitted in their original positions.

Draw the pole shoes and coils out of the yoke and lift off the coils.

In obstinate cases, the use of a pole shoe expander will be found helpful.



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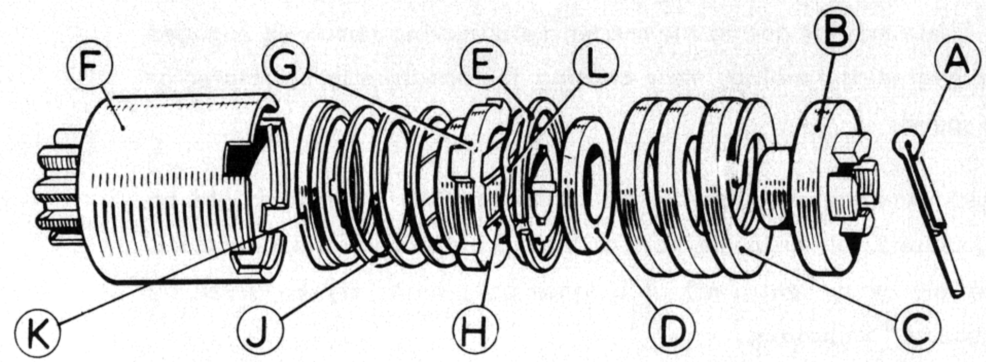

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Fit the new field coils over the pole shoes and place them in position inside the yoke. Ensure that the taping of the field coils is not trapped between the pole shoes and the yoke.

Locate the pole shoes and field coils by lightly tightening the fixing screws.

Replace the insulation piece between the field coil connections and the yoke.

Finally, tighten the screws by means of the wheel-operated screwdriver.

BEARINGS

Bearings which are worn to such an extent that they will allow excessive side play of the armature shaft must be replaced. To replace the bearing brushes proceed as follows:

Press the bearing bushing out of the end bracket.

Press the new bearing bushing into the end bracket using a shouldered, highly polished mandrel of the same diameter as the shaft which is to fit in the bearing, figure 1.

Porous bronze bushing must not be opened out after fitting, or the porosity of the bushing may be impaired.

NOTE: Before fitting a new porous bronze bearing bushing it should be completely immersed for 24 hours in clean thin engine oil.

RE-ASSEMBLY

This is, in the main, a reversal of the dismantling procedure.

COMMUTATOR END BRACKET REPLACEMENT

Pierce the through bolt indentations marked "C" on the replacement bracket.

Press the locating dowel into the hole marked "C".

Insert the through bolts into the holes made in the bracket and tighten the bracket to the yoke.

STARTER DRIVE, FIGURE 2

GENERAL

The pinion is carried on a barrel type assembly, which is mounted on a screwed sleeve.

This sleeve is carried on splines on the armature shaft and is arranged so that it can move along the shaft against a compression spring to reduce the shock loading at the moment engagement takes place.

When the starter switch is operated, the armature shaft and screwed sleeve rotate. Owing to the inertia of the barrel assembly, the latter is caused to move along the sleeve until the pinion comes into engagement with the flywheel ring. The starter will then turn the engine.

As soon as the engine fires and commences to run under its own power, the flywheel will be driven faster by the engine than the starter.

This will cause the barrel assembly to be screwed back along the sleeve, so drawing the pinion out of mesh with the flywheel teeth. In this manner the drive safeguards the starter against damage due to being driven at high speeds.

A pinion restraining spring is incorporated in the drive. This spring prevents the pinion vibrating into mesh when the engine is running.

ROUTINE MAINTENANCE

If any difficulty is experienced with the starting motor not meshing correctly with the flywheel, it may be that the drive requires cleaning. The barrel assembly should move freely on the screwed sleeve. If there is any dirt or other foreign matter on the sleeve it must be washed off with paraffin.

In the event of the pinion becoming jammed in mesh with the flywheel, it can usually be freed by turning the starter motor armature by means of a wrench applied to the shaft extension at the commutator end. This is accessible by removing the cap, which is a push fit.

DISMANTLING AND RE-ASSEMBLY

Remove the split pin (A) from the shaft nut (B) at the end of the starter drive. Hold the squared starter shaft extension at the commutator end by means of a wrench and unscrew the shaft nut (B).

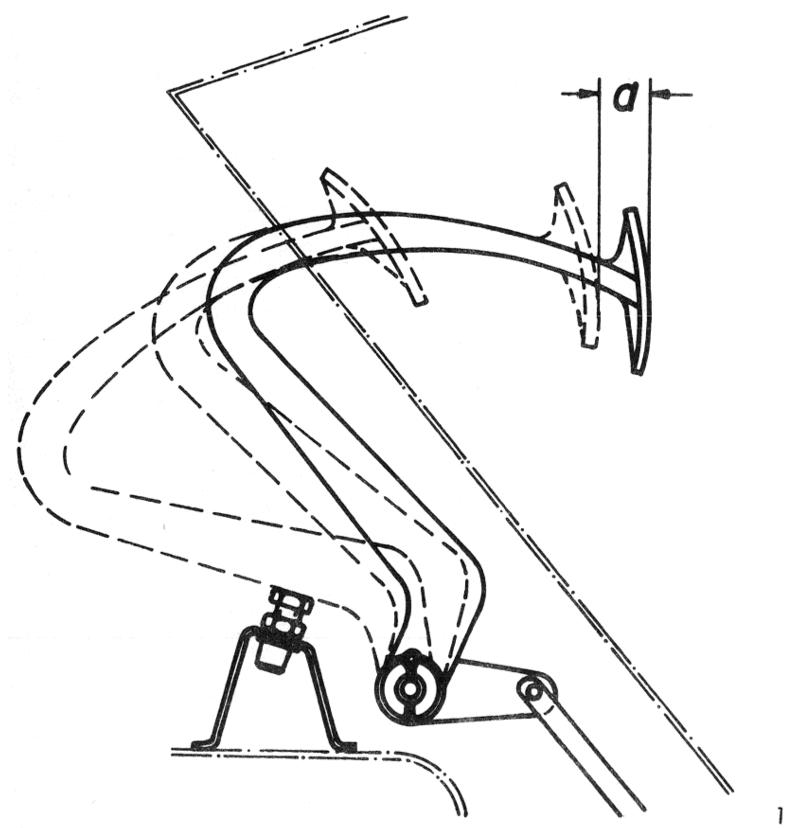
Lift off the main spring (C) and buffer washer (D) and remove the retaining (E) from inside the end of the pinion and barrel assembly (F). Control nut (G), sleeve (H) and retaining spring (J) will now slide off.

Withdraw the splined washer (K) from the armature shaft and remove the pinion and barrel.

The re-assembly of the drive is a reversal of the dismantling procedure.

NOTE: Should either the control nut or screwed sleeve be damaged, then a replacement assembly of screwed sleeve and control must be fitted.

These components must not be renewed individually.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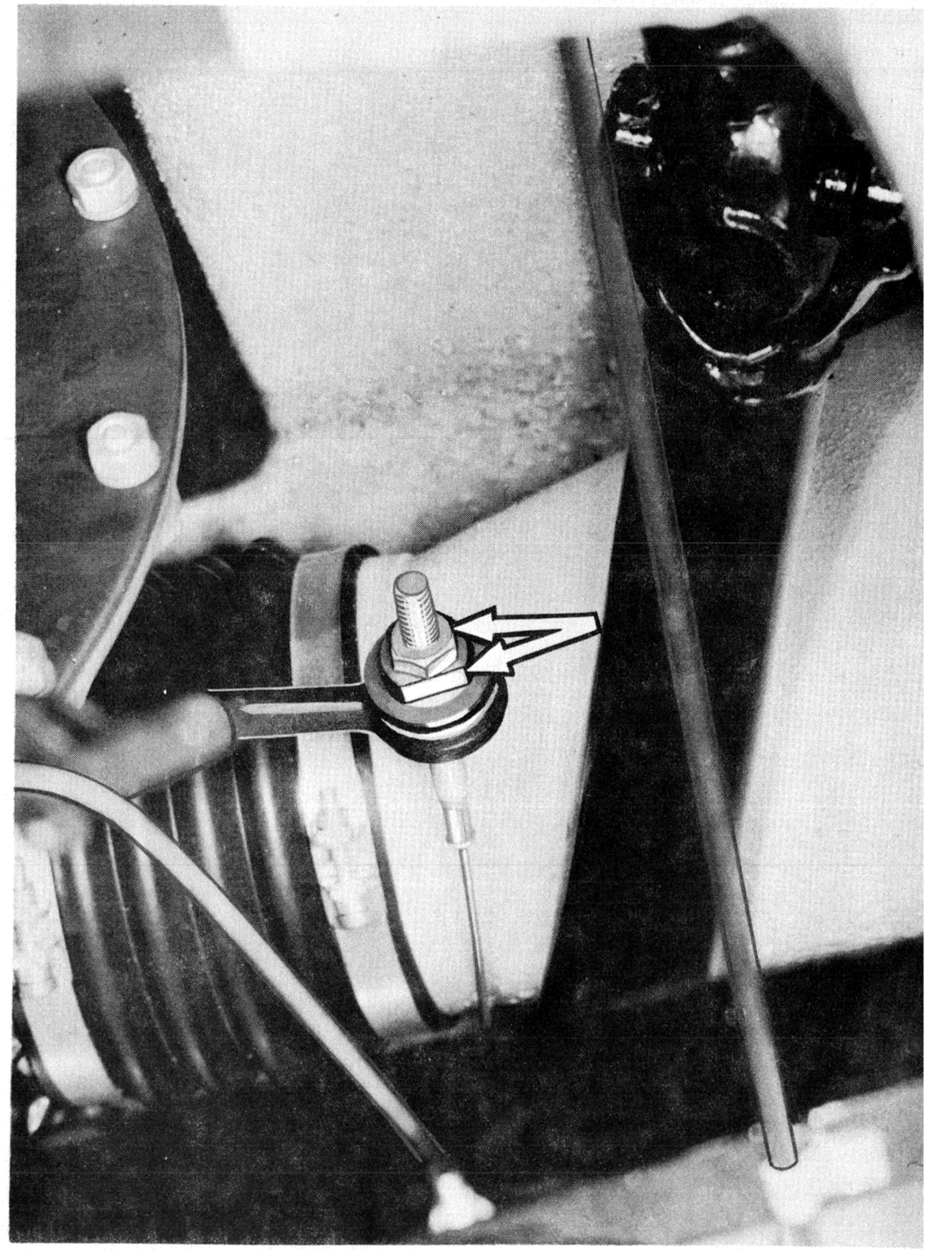


CLUTCH

DESCRIPTION

The clutch of the Amphicar is a dry plate clutch.

It consists of:	Pressure plate assembly
	Driven plate
	Shift fork with shift bearing
	Clutch housing

METHOD OF OPERATION

The cover, mounted on the flywheel by means of six bolts, encloses the pressure plate assembly, the driven plate and the clutch springs with their casings. Three release levers, acting upon the driven pins of the pressure plate assembly rest with their longer, inner arms on the release lever plate. The latter is held against the release levers by three retaining springs.

When pressing down the clutch pedal, the graphite throw out bearing presses the release levers, thus disengaging the driven plate from the pressure plate.

SPECIFICATIONS

Dry plate, type 4770 Borg & Beck

Driven plate diameter 6 1/4"

Number of thrust springs 9 (dark blue)

Compression rating 60   75-85 lbs.

Compression rating 30   90-100 lbs.

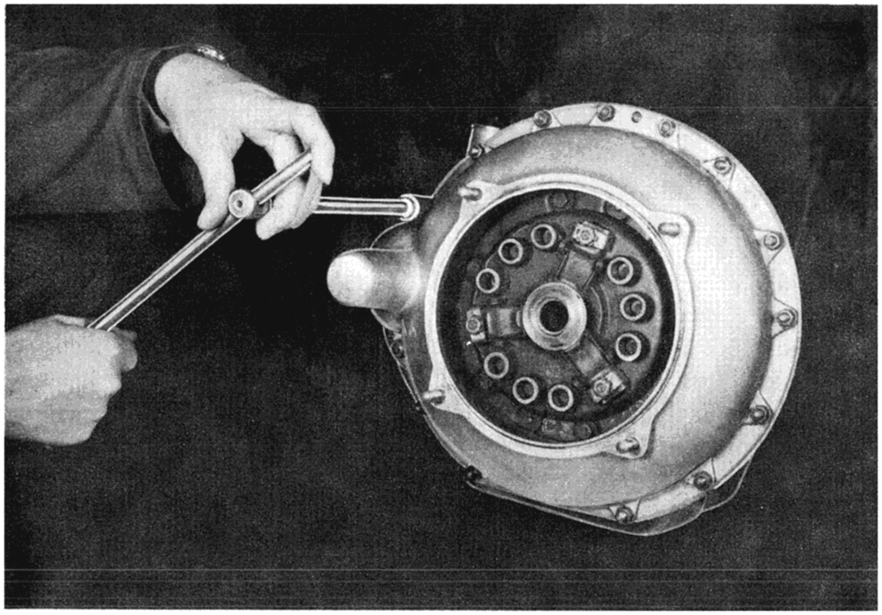
Release thrust (approximately) 350 lbs.

Clutch lining type M. 19

CLUTCH ADJUSTMENT

Since the clutch is subject to wear, it is important at the specified servicing times, to check and to correct the play. Play of the clutch pedal should be .75" (Fig. 1 a), play between release lever ring and clutch ring-.06". When adjusting the clutch, it is necessary to dismantle and remove the back seat and seat rest as well as the seat base (see 11/4, Fig. 1 and 2). When adjusting the clutch play (Fig. 2) follow specifications exactly as indicated, as the clutch is subjected to great wear and tear, when the clutch play is too low. If the clutch play is too great, it is possible that the clutch will not disengage. This puts excessive stress on the gear Synchromesh.

If it is found that the clutch does not disengage even when the clutch play is correctly adjusted, the clutch must be dismantled and overhauled.



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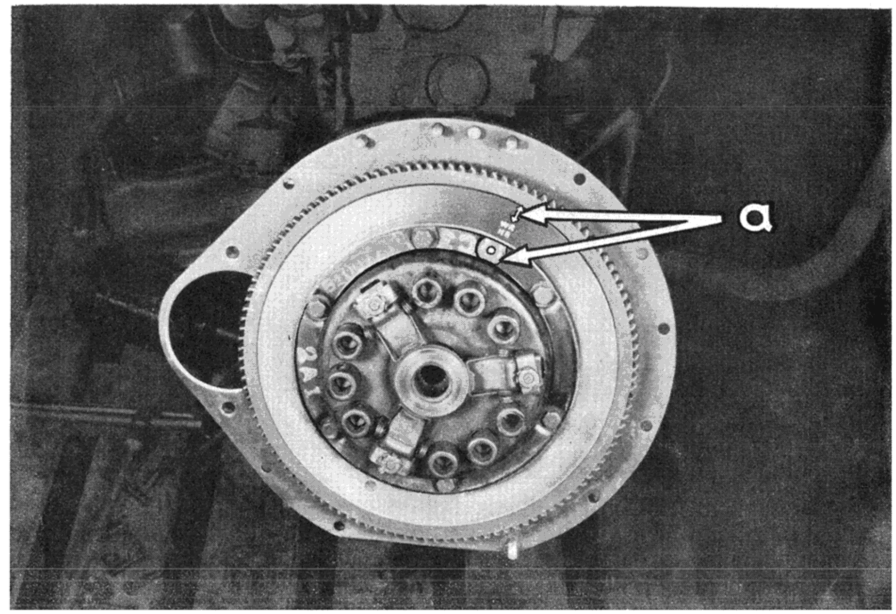

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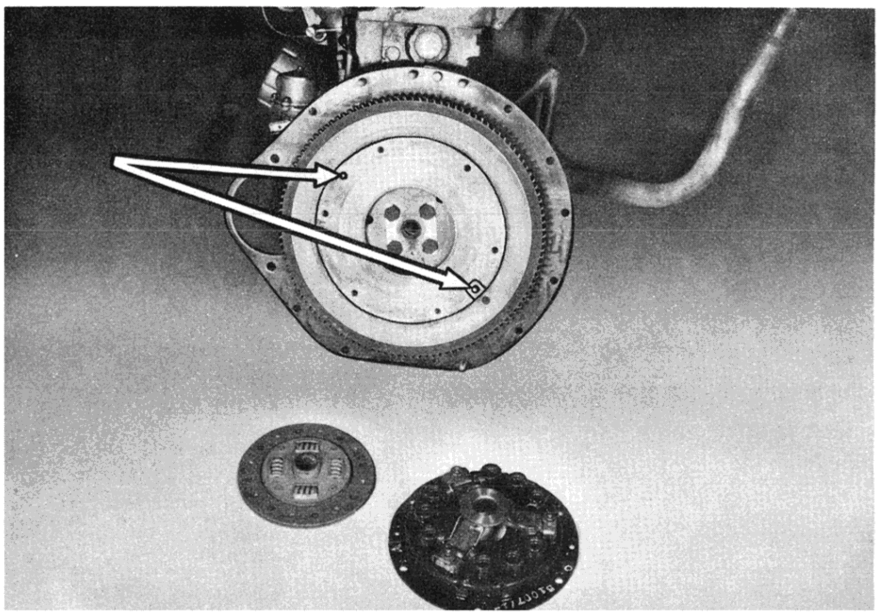

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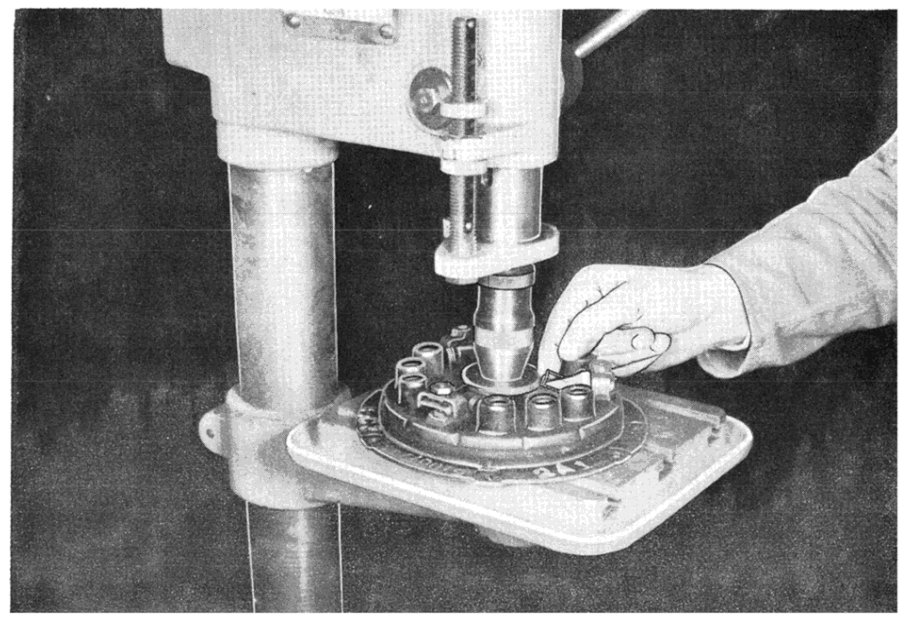

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DISMANTLING AND REASSEMBLY OF CLUTCH

Remove engine (described on 1/13) and place on a work bench. Disassemble clutch housing securing bolts (Fig. 1), lift off clutch housing.

Loosen securing bolts, holding the pressure plate to the flywheel plate evenly and crosswise, so as not to deform the assembly (Fig.2). Mark pressure plate and flywheel plate, to avoid any imbalance when reusing (Fig. 2 a).

Remove clutch pressure plate assembly and driven plate (Fig.3). The arrows indicate both dowel pins.

CHECKING OF CLUTCH

After dismantling the pressure plate assembly, check the bushing in the crankshaft and the pin of the drive shaft for wear and tear. The maximum permissible play between the pin and the bushing guide is .006". Replace bushing, if play is excessive.

At each dismantling of the clutch housing it must be checked for cracks as well for deformation, warping and unevenness of the joined surfaces. If faulty, replace.

This inspection must be carried out with extreme care, as, in case of warping of the clutch housing, not only will the driven plate be subject to excessive stress, but also the drive shaft of the gear-box.

The bearing of the release fork for the clutch in the gearbox, as well as the springs and the clutch ring with the form springs must be checked. If the parts are worn out, they must be replaced.

CLUTCH AUTOMAT

To replace the release lever plate bolt the clutch to a clutch-tensioning device and tighten the release lever plate with the center pinion. The retaining release lever springs are removed from their support on the release lever plate and the center pinion of the tensioning device is loosened.

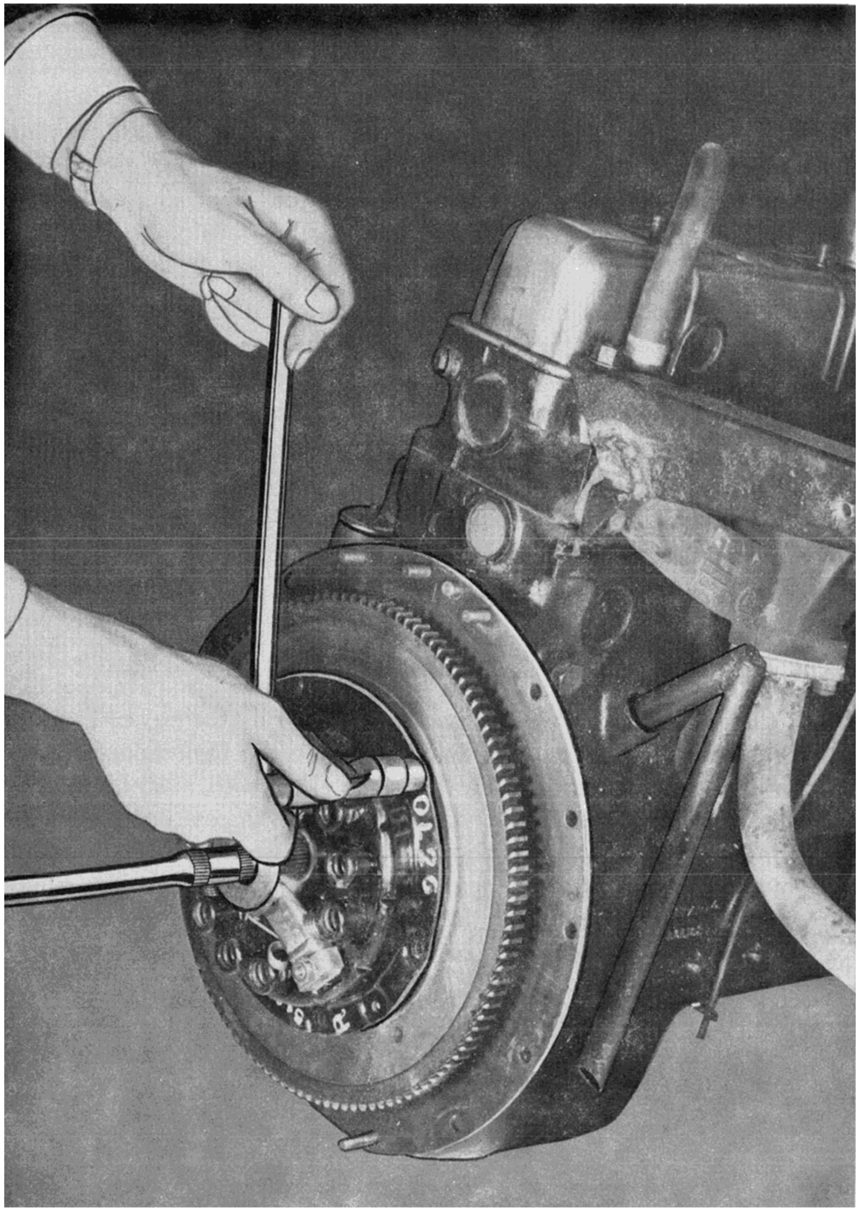
NOTE: If no clutch tensioning device is available, use a post drill by pressing the mandrel of the drill against the release lever plate and thus being able easily to lift the retaining release lever springs (Fig. 4).

It is not recommended to dismantle a clutch pressure plate assembly if no clutch tensioning device is available (for example, if the pressure assembly plate is worn out, or the release lever is worn out, or in cases of reduced pressure of the springs due to overheating).

In such cases it is recommended to replace the clutch.

CHECKING OF DRIVEN PLATE

Check clutch facings for wear. If worn facings, oily facings or scorings are found, the facing must be replaced. When the facings are riveted on, the driven plate must not be deformed. The rivets must be headed correctly, for they must not, under any circumstances, protrude from the facings. Driven plate with damaged torsion springs, or their mountings, must be replaced. Maximum permissible side play is .12". Check the vertical play of the hub on the splines (.04") and the backlash .16".



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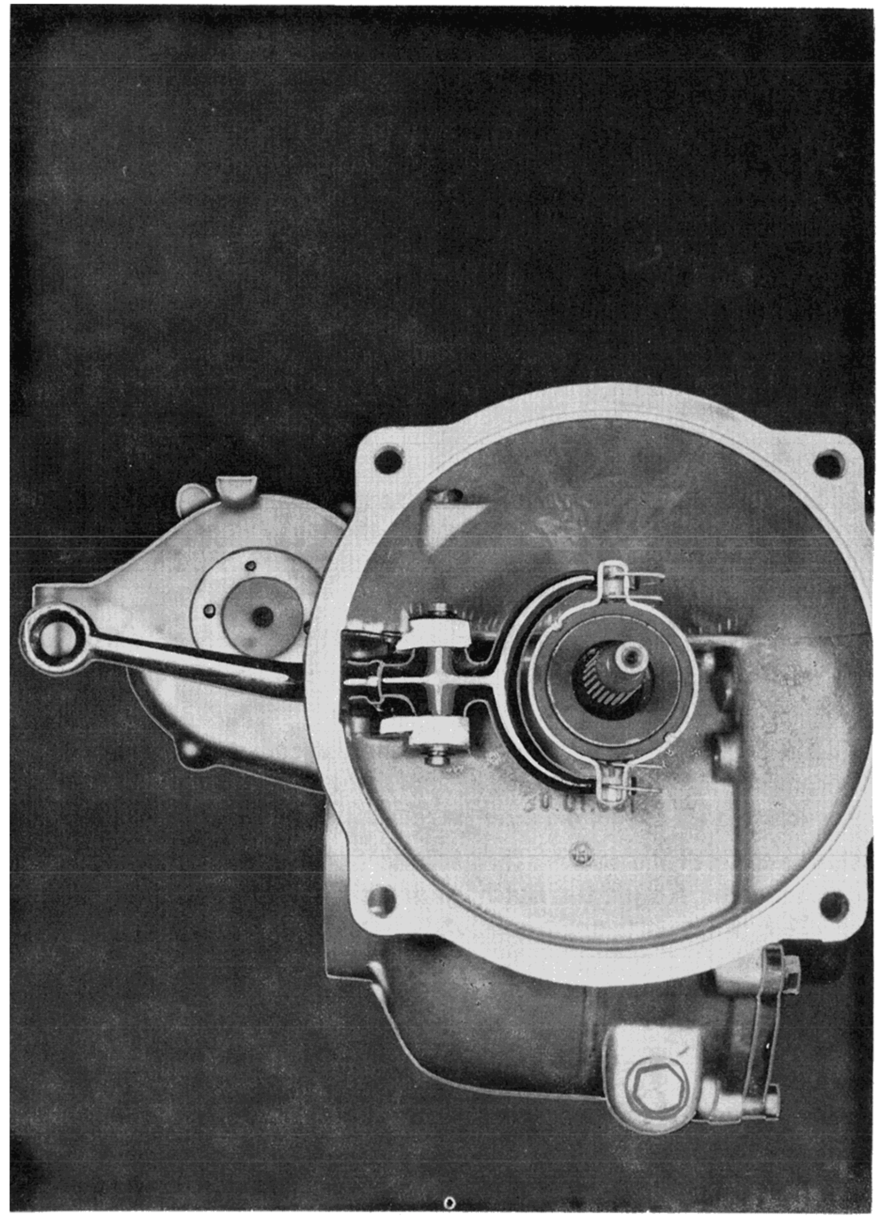

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If the driven plate does not glide freely on the splined shaft, the fault must be remedied, for this could cause difficulty when disengaging the clutch.

ASSEMBLY

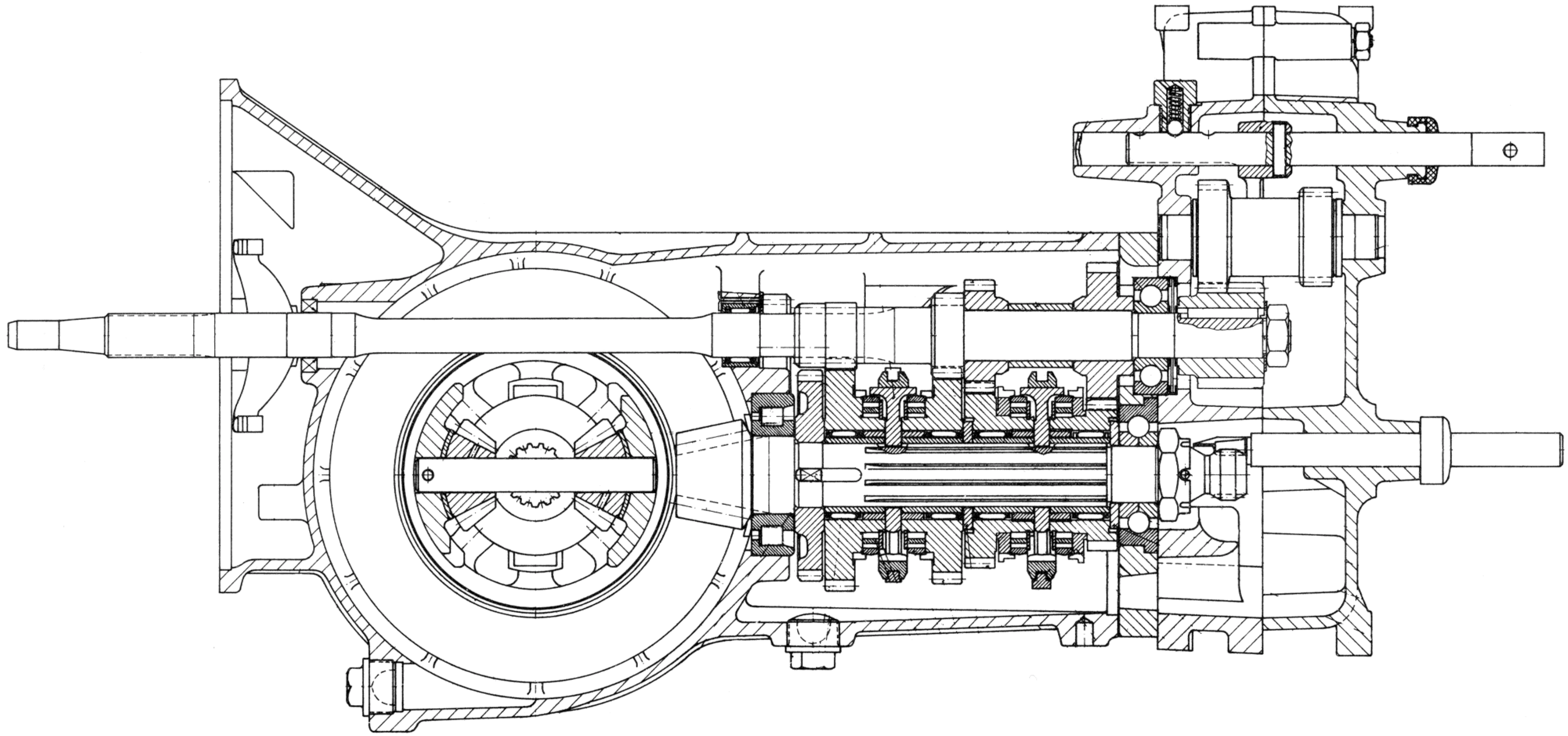
When reassembling the clutch, act in reverse order than during dismantling. Pay special attention to the following:

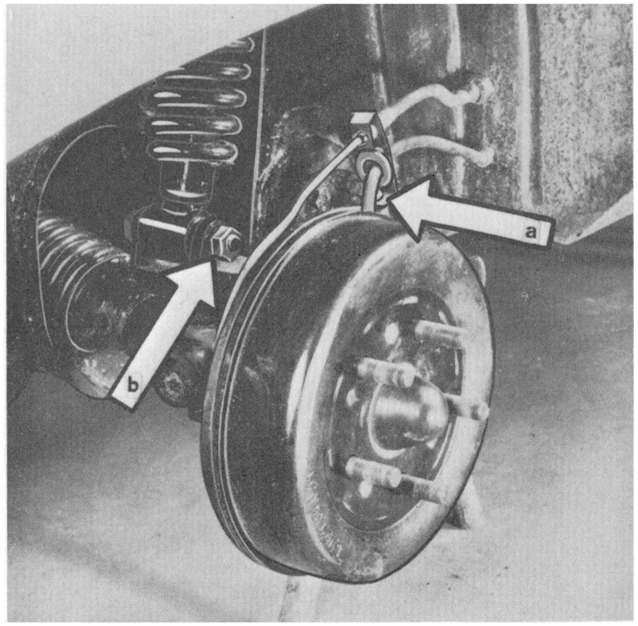
When fitting the driven plate and the pressure plate, a guiding tool is absolutely required in order to center the clutch exactly. Otherwise difficulties may arise when fitting the engine into the gearbox, as the drive shaft of the gearbox will not line up with the spline of the driven plate and into the guide bush of the crankshaft (Fig. 1).

Pay attention to the marking of the flywheel and of the pressure plate (to be done when dismantling), so that it can be remounted in its original position.

Tighten the securing bolts of the clutch pressure plate assembly evenly and alternately.

Fig.2 shows the release assembly in the gearbox.





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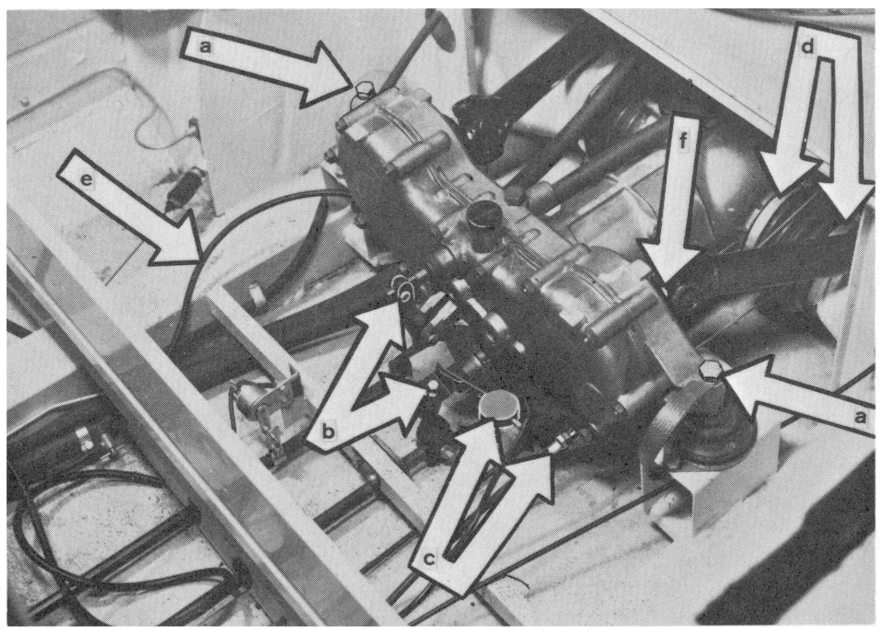

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GEARBOX = REMOVAL AND REFITTING

1. Remove rear wheel hub cap and slacken off the rear wheel nuts, before raising the vehicle as described on page 1-9, group 1, figure 1 and 2.
2. Unscrew and remove the oscillating arm clamping bolt, and coil spring bottom fastening bolt with a 22 mm wrench, figure 1 "a", "b" .
3. Remove the oscillating arm with the special tool AC 16.
4. Draw the drive shaft out of the gearbox splined bore, and carefully place to one side, making sure that the brake hose and cable are not strained or damaged.

ATTENTION

When drawing the drive shaft out, take care to support the shaft as near as possible at the gearbox end with one hand, to prevent damaging the rubber bellows, and to avoid the possibility of the drive shaft from being parted in the middle.

5. Remove the rear seat complete with seat base out of the vehicle.
6. Disconnect the gearshift levers, clutch cable, and speedometer drive cable, see figure 2 "b" and "e".
7. Disconnect throttle cable and reversing light switch brackets, figure 2 "c".
8. Unscrew both hexagon bolts in the gearbox rubber mountings, see figure 2 "a".
9. Remove the propeller drive shaft screws as shown in figure 2 "f".
10. Unscrew and remove the rubber bellows, figure 2 "d", fastening clips, and the four hexagon bolts fastening the gearbox to the engine flange.
11. Before removing the gearbox, it is important to support the engine under the clutch housing.

REFITTING THE GEARBOX

The gearbox is installed in the reverse order, for this operation take care of the following points:

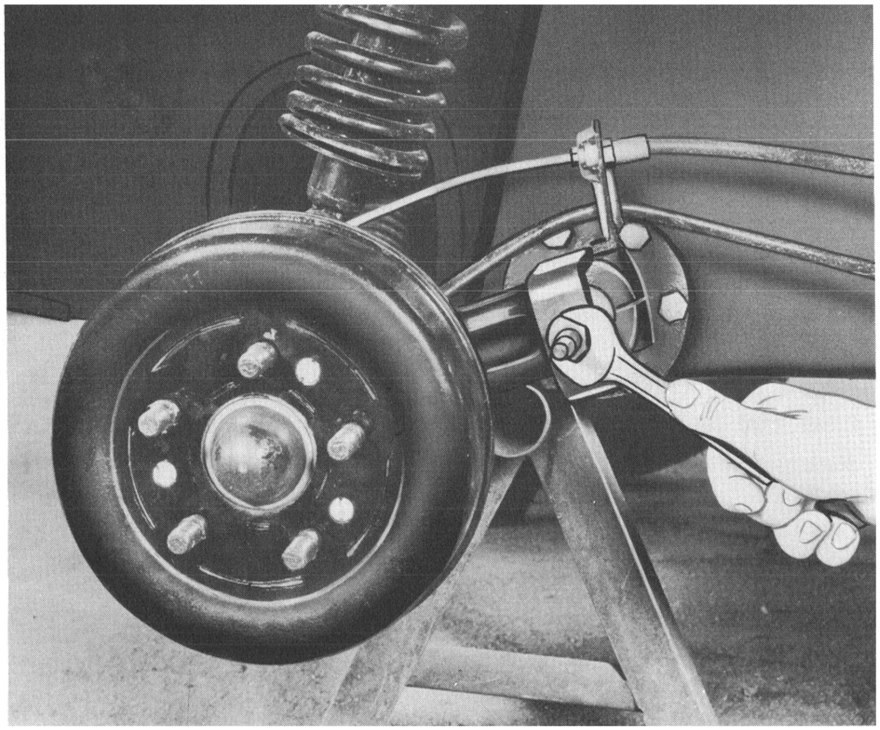
When inserting the splined end of the drive shaft into the gearbox, make sure the shaft is in the horizontal position, to avoid damaging the differential radial oil seal.

Fit the rubber bellows with the special tool AC 31. Before installing these must be carefully inspected, ensuring that they are not porous or damaged in any way. Should any damage be found, install new rubber bellows.

ATTENTION

When tightening the rubber bellow clips pay attention to the following:

a. Take care when tightening the clips that the screwdriver does not slip and therefore damage the rubbers.
b. Pay attention to the proper location of the clips, to ensure that the rubbers are watertight.



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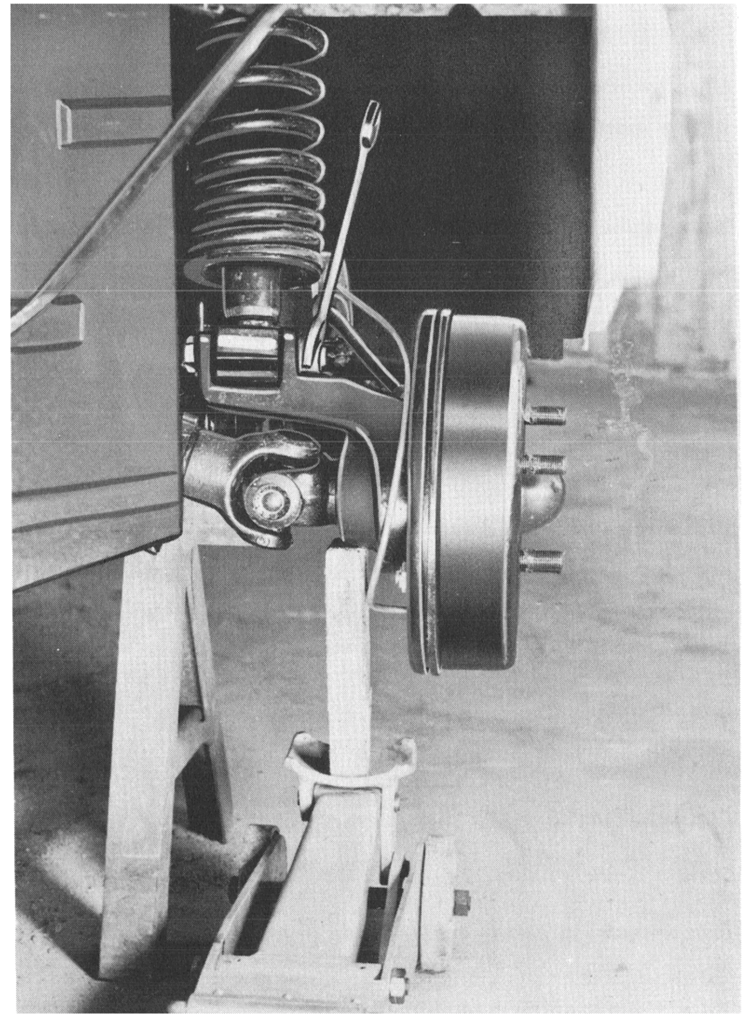

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1. When refitting the oscillating arm on the axle use the special tool AC 15 together with AC 22 as shown in figure 1.
2. After positioning the coil spring bottom fastening bolt, raise the oscillating arm with a jack, see figure 2, to enable the coil spring with damper to obtain its normal loaded position. Still raised finally tighten the hexagon bolt.

This operation will prevent any unnecessary wear to the silent block as the oscillating arm swings.

GEARBOX

DESCRIPTION

The gearbox consists of a Synchro-mesh gear shift box, and a forward and reverse gear shift normal water transmission box.

The engine torque is carried over the clutch to the transmission shaft and then to main shaft and the differential, from there to the propeller shafts and rear wheels.

By water driving the engine torque is carried over the clutch to the transmission shaft and is then conveyed to the water transmission box, and eventually to the propellers.

All gear wheels are of the helical type and are always in mesh. The gear wheels of the forward gears on the main shaft are running on needle bearings and are Synchro-mesh, whereas all gear wheels of the water transmission box are running on ball and needle bearings.

Changing gear is easy and noiseless without giving intermediate gas or double movement of the clutch, owing to being a Synchro-mesh box.

But it is most important that the clutch adjustment is correct. Otherwise an unnecessary wear will occur to the Synchro-mesh and the reverse gear wheels.

RECOMMENDED MAINTENANCE

1. Check the gearbox for any possible leaks.
2. Check the tightness of all nuts and bolts.
3. Change oil after the first 500 miles and then every 12.000 miles.

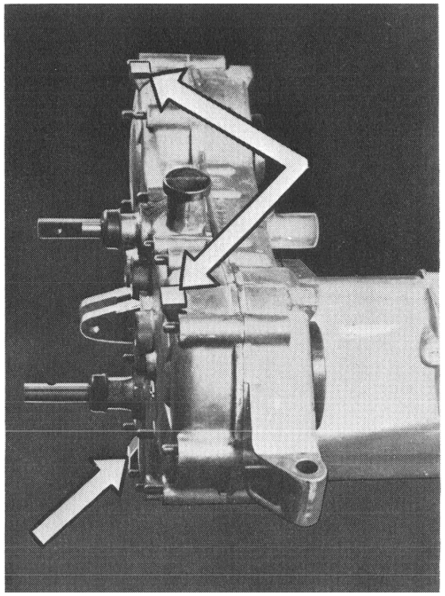
Oil capacity 4 speed box	3,520 imp.pints (2 ltr.)
Oil capacity water transmission box	1,760 imp. pints (1 ltr.)

TECHNICAL DATA GEARBOX

Number of gears	4 forwards, 1 reverse (Synchro-mesh) Ratio.
1st Gear	1 : 4,50
2nd Gear	1 : 2,91
3rd Gear	1 : 1,75
4th Gear	1 : 1,05
Reverse Gear	1 : 4,13
Differential 7 : 33 = teeth	1 : 4,72

WATER TRANSMISSION BOX

Number of gears	1 forward, 1 reverse with sliding gear wheel shift.
	Ratio
Forward gear	1 : 3
Reverse gear	1 : 3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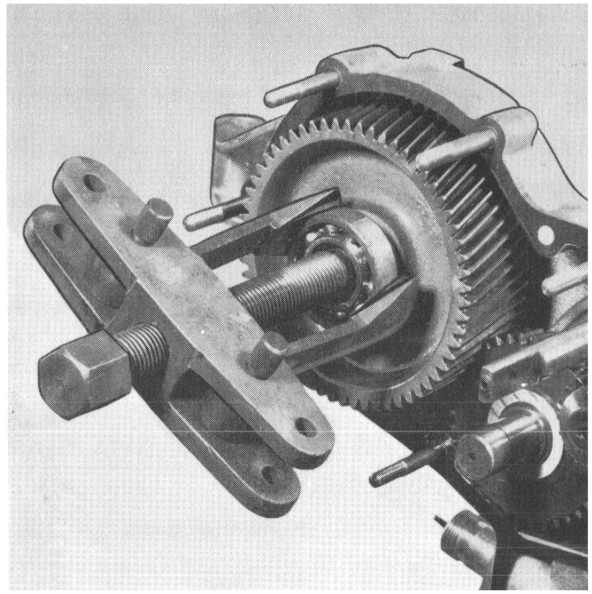
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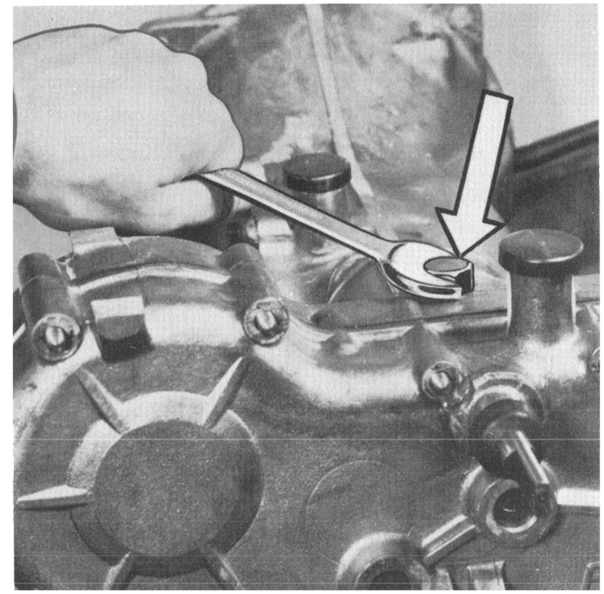
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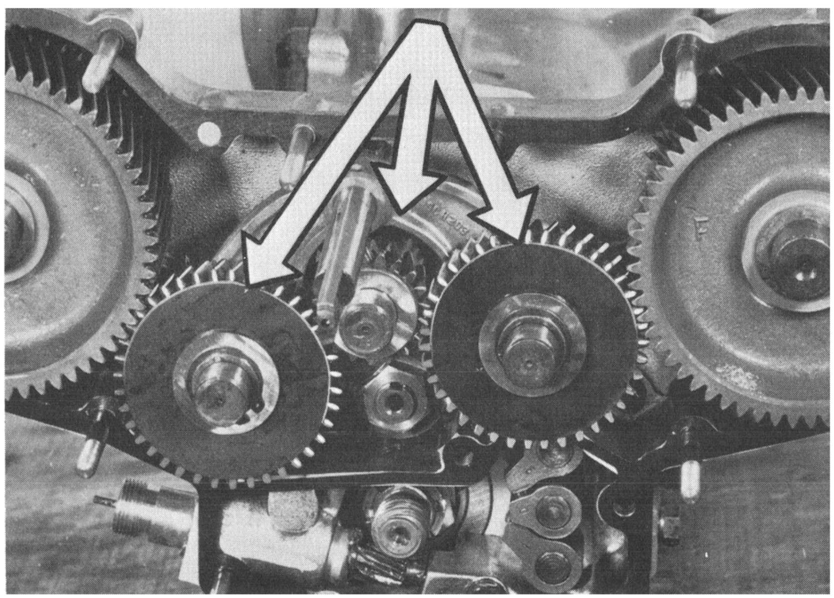
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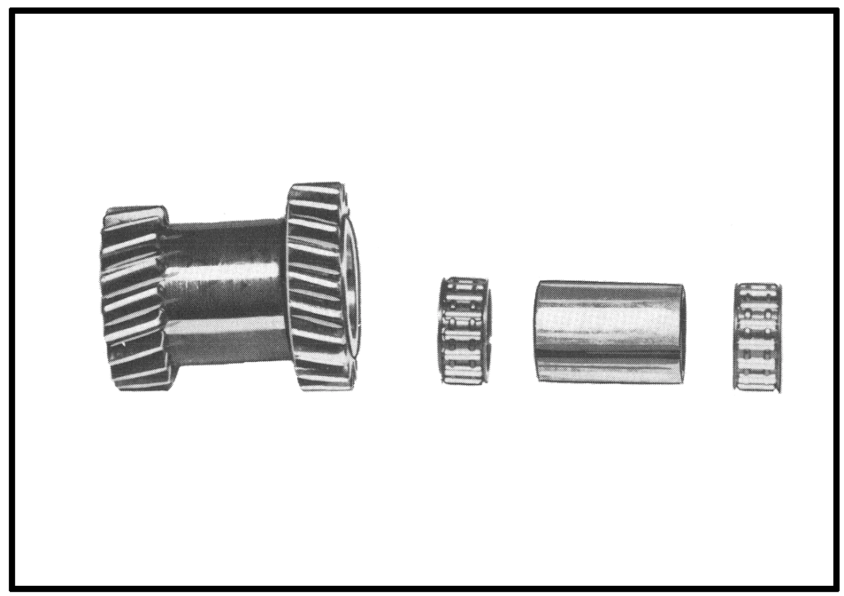
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ADJUSTMENT DATA

NUTS AND BOLTS TIGHTENING TORQUES

	Range lb.ft.
Crown wheel bolts	43.4 - 50.6
Main shaft nut	(approx.) 86.8
8 bolts in gearbox case, and also 4 inside bolts	18.0 - 21.6

4 SPEED BOX

Measurements from main shaft gear end to the last buffer disc	7,882" (200,20 mm)
Axial clearance	
1st. 2nd. 3rd. 4th gears	0,006" - 0,01" (0,15 - 0,25 mm)
Untrue running from the needle bearing (max.)	0,001" (0,02 mm)

DIFFERENTIAL

Axial clearance of the pinion gear	0,008" - 0,02" (0,2 - 0,5 mm)
Axial adjustment of the main shaft measurement from middle differential to the end face of housing, including gasket	10,331" (262,4 mm)
Measurement from main shaft middle to the differential bearing seat	2,677" (68,0 mm)
Press fit of ball bearing in the water transmission box	0 to +0,004" (0,1 mm)
Measurement between the seating face of both ball bearings	5,358" (136,1 mm)
Length of differential case	5,354" (136,0 mm)
Housing cover fit	0,004" (0,1 mm)
Flank clearance between crown wheel and bevel gear	0,006" - 0,01" (0,15 - 0,25 mm)

The water transmission box, both intermediate gear wheels in the axial direction are 0,024" (0,6 mm) out of parallel with each other, but are shifted together with the same double selector fork.

DISMANTLING THE GEARBOX

1. After draining the oil from the four speed, and water transmission box, it is advisable to mount the complete unit on a special stand so that the clutch flange is pointing downwards, and that the drive shaft is fully free.
2. Remove the water transmission box cover nuts, and unscrew the one alien screw, then by light crosswise tapping with a plastic or rubber hammer on the cast on lugs, the cover is easy to remove, see figure 1.

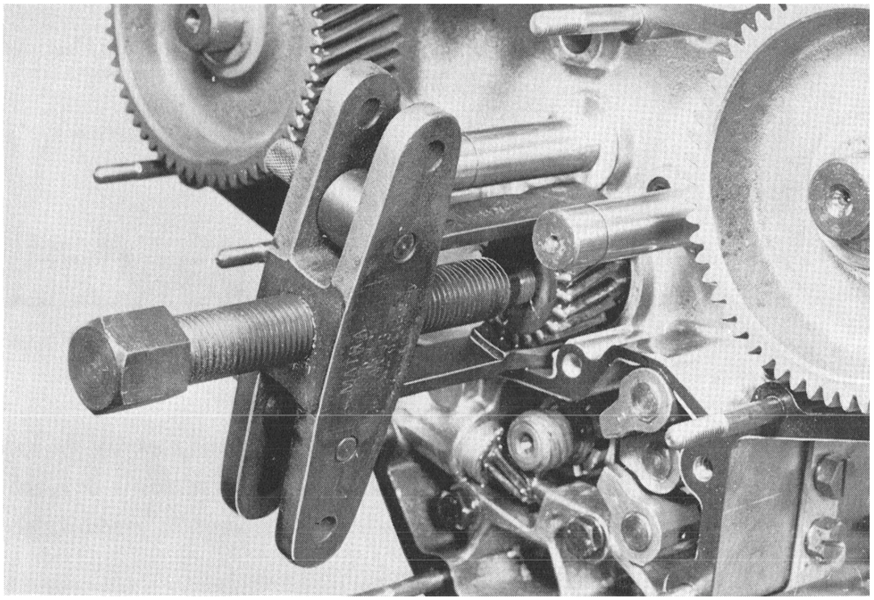
   ATTENTION

   Do not use any edged tools to pry the cover off.

After removing the cover it is possible that the grooved ball bearings 6205 stay on the drive shaft stub. If so, use the special tool AC 43 as shown in figure 2 for removal. Should the grooved ball bearings stay in the cover and must be removed, then use a normal interior extractor.

3. Unscrew the position plug screw, figure 3, but take care that the position ball does not fallout. Now the double selector fork together with both intermediate gear wheels can be removed, figure 4.

Remove the double driving gear wheel with both needle bearings and distance bushing as shown in figure 5.



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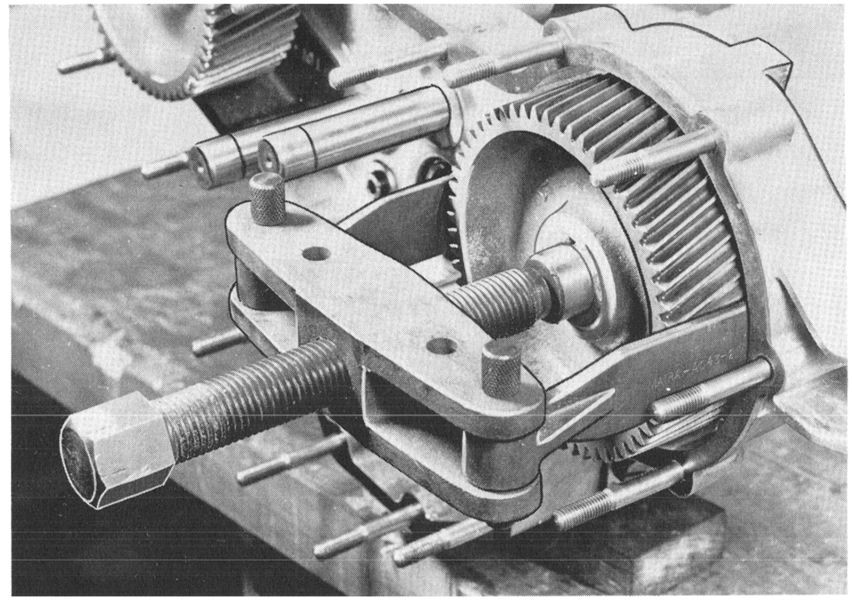

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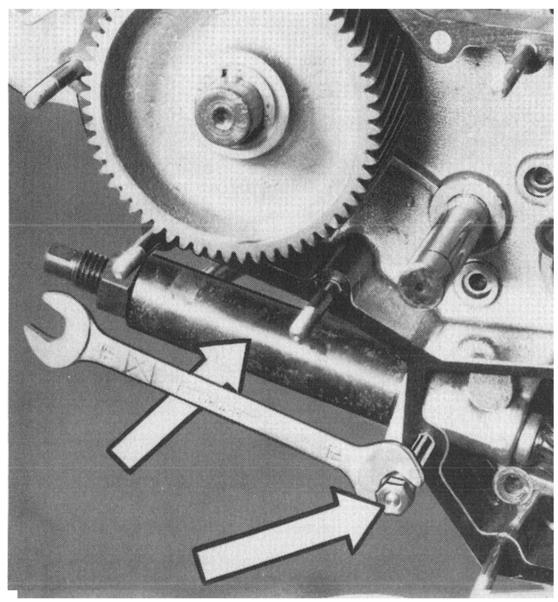

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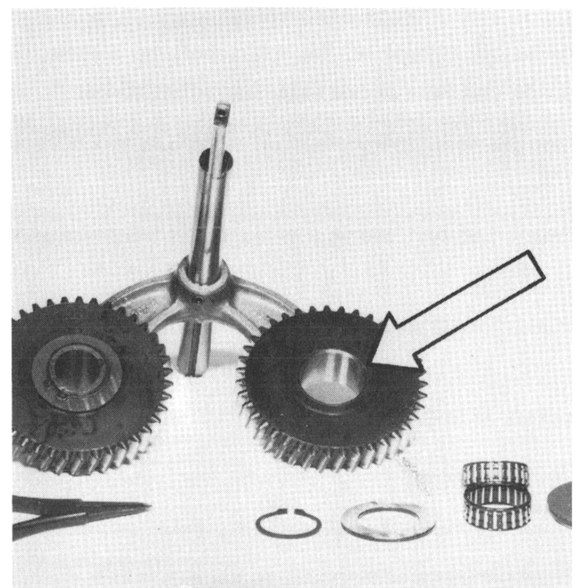

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4. Remove the top and bottom selector fingers. By removing these the four speed box will be blocked. Unscrew and remove the driving shaft nut.

   Remove the driving gear wheel with a puller from the driving shaft, figure 1.

5. Unscrew and remove the exposed inside bolts together with two hexagon screws.
6. The water transmission gear box can now be removed from the four speed box.

   To dismantle the remaining parts of the water transmission box, the following procedure will be necessary:

7. Use a puller AC 43 to remove both pinion wheels from the input shafts, figure 2.
8. Remove both woodruff keys from the input shafts, and then use a drift and hammer. Remove both input shafts from the water transmission box, figure 3.
9. Remove the ball bearing pressing from the outside to the inside of the case, and then remove the input shaft oil seals in the opposite direction, from inside to the outside.
10. The large outside water transmission box gear wheels are separately replaceable, but should new ones be fitted, it is important that the minimum tooth play does not exceed 0,005" (0,12 mm).

    ATTENTION

    When lifting the gearbox, only lift by holding the housing. On no account should the gearbox be lifted with the free end of the drive shaft.

To remove the speedometer drive pinion, remove as shown in figure 4, the one screw, and then use the special tool AC 44 to remove the bearing bushing.

Reassembling of the water transmission box is in the reverse order, taking care of the following points:

a. Always renew the radial oil seals and cover gasket.
b. Check all ball races, renew if necessary.
c. When refitting both intermediate gear wheels attention must be paid to the correct fitting, the R/H gear wheel has a small shoulder, whereas the L/H gear wheel is flat, see figure 5.

DISMANTLING THE 4 SPEED BOX

1. The gearbox fourth and reverse gear are still in the blocked position. Therefore remove the split pin from the hexagon nut, finally unscrew and remove using a 36 mm wrench.

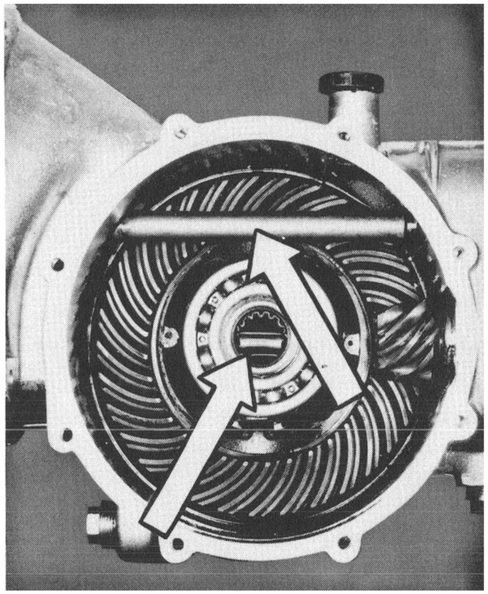
   ATTENTION

   The main shaft nut has a left hand thread to slacken off, turn clockwise.

2. Remove the top position plug from the base plate, but taking care that the position ball and spring don't spring out and get lost while removing.
3. Unscrew and remove the 8 hexagon bolts from the differential cover. Remove cover.

   ATTENTION

   While removing cover, avoid using any sharp edged tools to pry cover off. This would damage the machined faces.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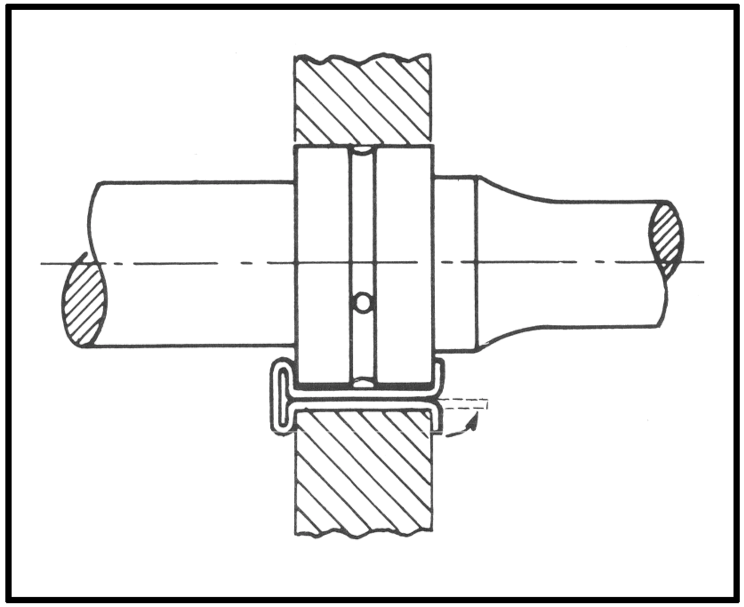
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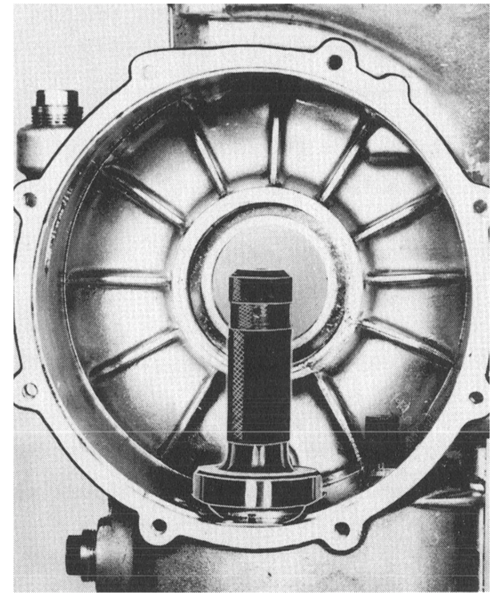
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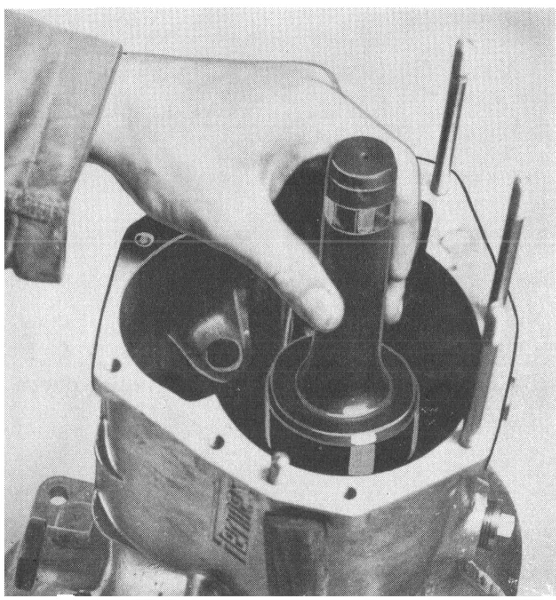
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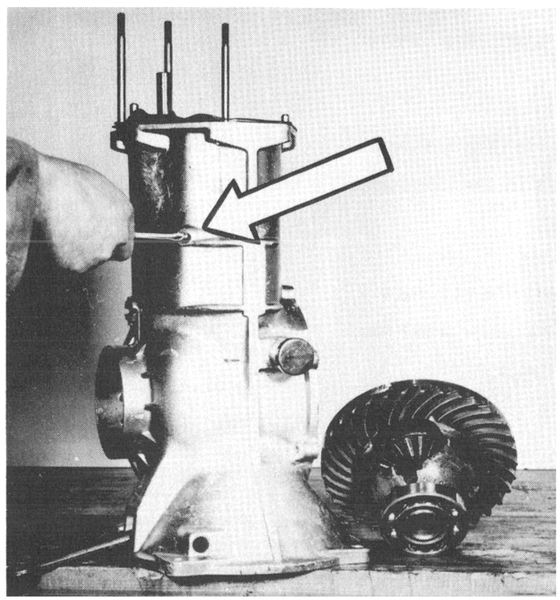
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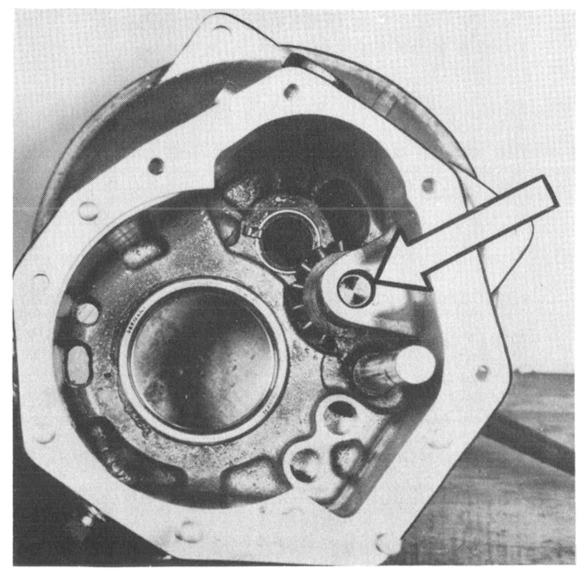
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4. Turn the differential housing, until the opening is parallel to the driving shaft, figure 1, and then through driving the expanding pin out of the reverse gear selector finger, the reverse gear is no longer engaged. The unit together with base plate can now be removed from the gearbox housing.

   ATTENTION

   To save time and trouble it is advisable to measure and note the thickness of all gaskets and thrust washers after removal.

REMOVING THE NEEDLE BEARING

5. The needle bearing of the driving shaft is locked with a special key lock, the ends of which must be bent straight before removing the needle bearing, see figure 2.

6. Drive the needle bearing out with a punch of the correct diameter with a one sided flat, drive out from the differential side in the direction of the water transmission box end.

   ATTENTION

   After each dismantling of the gearbox it is most important to re-new all oil seals. Always use the special tools AC 40 and AC 41 for refitting oil seals.

   Removal and refitting the cylindrical roller bearing (outside ring). For the removal operation the special tool AC 33 will be needed, and for assembling special tool AC 34, figure 3 and 4.

REVERSE IDLER GEAR WITH SELECTOR ROD AND FORK

REMOVAL AND ASSEMBLING

1. Unscrew and remove the grub screw, see figure 5 and 6, and drive the reverse idler shaft out in the differential direction.

   IMPORTANT

   Check all removed parts for damages or faults.

   Renew any damaged part.

ATTENTION WHEN ASSEMBLING

2. Drive the reverse idler shaft just far enough into the hole, so that the reverse idler gear and selector fork can be placed into position. Before finally driving the idler shaft to its correct position, align the grub screw hole correctly.

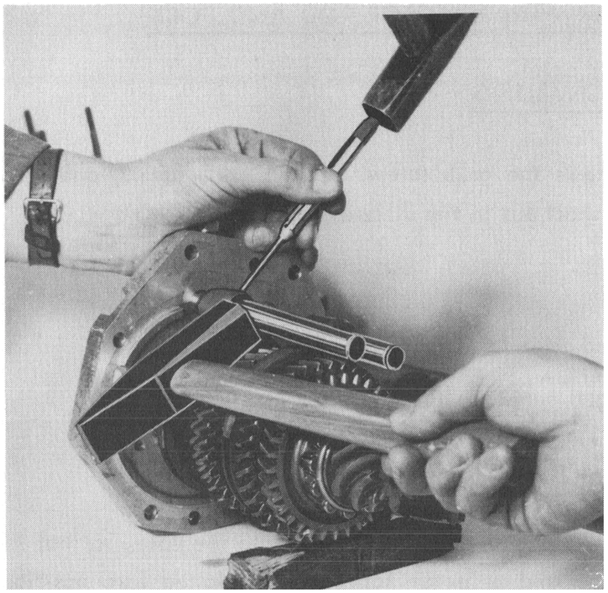
CLUTCH RELEASE FORK AND SPRING

REMOVAL AND ASSEMBLY

3. Remove the top and bottom circlips from the shaft. Support the cast on lugs of the release lever mounting with a hammer or rubber mallet, and then with a punch and hammer, drive the shaft out.

   ATTENTION

   Owing to the bushing being damaged while driving the shaft out, new bushing must always be refitted.



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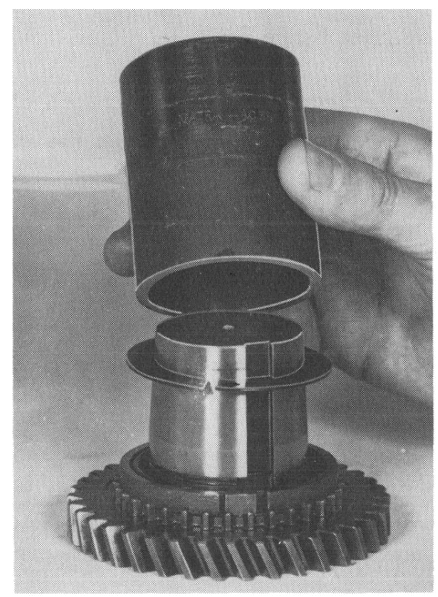

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OVERHAULING THE 4 SPEED GEARBOX

DISMANTLING

1. Mount the unit in a vice, using aluminum alloy between the jaws while clamping the base plate.
2. Remove the two expanding pins which secure the selector forks, but when driving these out, support the selector rods with a rubber mallet, as shown in figure 1.
3. Unscrew and remove both plug screws, pressure springs, and both balls with check pins. Now remove the selector rods and selector forks.
4. Unscrew and remove the drive shaft and main shaft nuts.
5. Place two blocks 8,661" (220 mm) in length under the main shaft and place both under a press. Slowly press the needle bearing bushing off.

IMPORTANT

Before removing gear wheels and needle bearings it is most important to mark each part, to ensure that by reassembling the parts return to their original position.

6. Press the roller bearing inside bushing off.
7. Remove the key from the reverse idle gear wheel position.
8. Check all dismantled parts, including the Synchro-mesh for wear or damage.

After having checked the Synchro-mesh, the holding circlips must always be renewed when reassembling.

ASSEMBLING

REFITTING THE SYNCHRO-MESH MECHANISM

ATTENTION

The Synchro-mesh mechanism of the 1st gear is different from that of the 2nd, 3rd and 4th gear, take care not to interchange this mechanism, see figure 2, 1st gear. Figure 3, 2nd, 3rd and 4th.

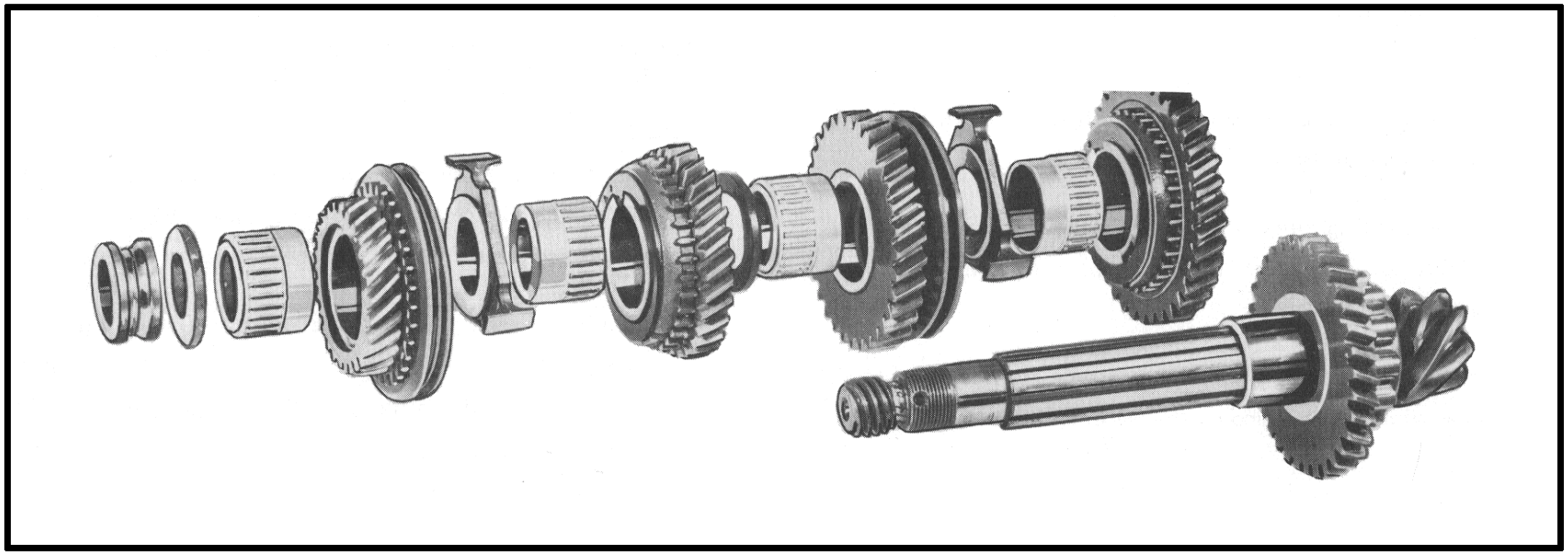
1. As shown, the outside circlips are fitted together with a sliding sleeve placed on the gear wheel and with aid of the special tool AC 39 correctly aligned with the groove in the gear wheel and pressed into position, see figure 4.
2. After this operation has been carried out, it is most important to check that the Synchro-mesh ring and segments have free movement.
3. Press the roller bearing inside ring onto the main shaft.

ATTENTION

The roller bearing must not bear on the bevel gear, approx. 0,02" (0,5 mm) clearance.

4. Refit the key for the reverse gear in the keyway, but allowing 0,394" (10 mm) distance from the bevel gear wheel.

   Place the reverse gear wheel with the shoulder facing the bevel gear and correctly aligned to the keyway and press it concise to its rest position.



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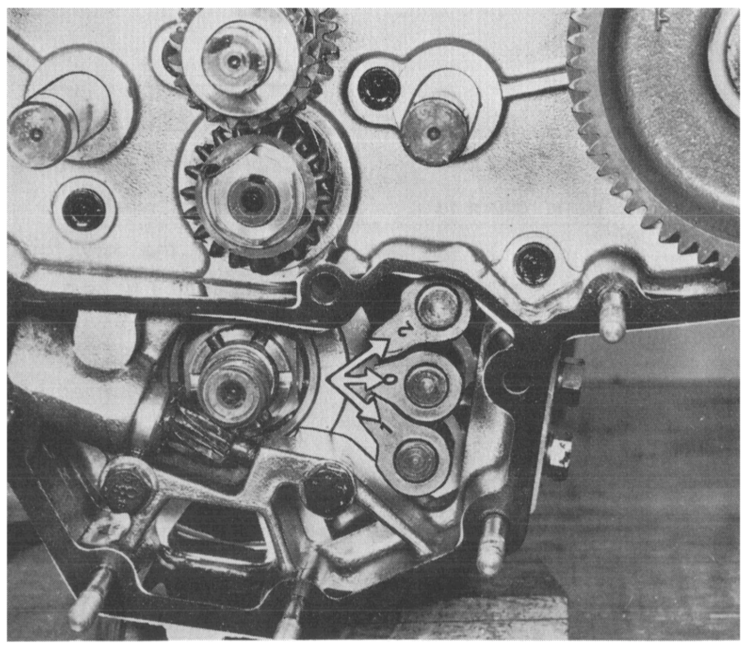

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The following parts can then be fitted in the following order Figure 1.

1. Main shaft.
2. Cylindrical roller bearing.
3. Reverse gear wheel.
4. Needle bearing.
5. 1st gear wheel.
6. Sliding ring with profile ring.
7. Needle bearing.
8. 2nd gear wheel.
9. Thrust washer.
10. Needle bearing.
11. 3rd gear wheel.
12. Sliding ring with profile ring.
13. Needle bearing.
14. 4th gear wheel.
15. Thrust washer with oil grooves.

After fitting all parts on the main shaft finally press again to make certain all parts are in their correct position.

ATTENTION

Thrust washers are obtainable in 6 different thicknesses. Therefore the measurement of 7,882" (200,2 mm) can be obtained.

Finally press the angle ball bearing inside ring onto the main shaft.

Check the axial clearance of the 1st, 2nd, 3rd and 4th gear wheels, this should be 0,006" - 0,01" (0,15 - 0,25 mm).

ATTENTION

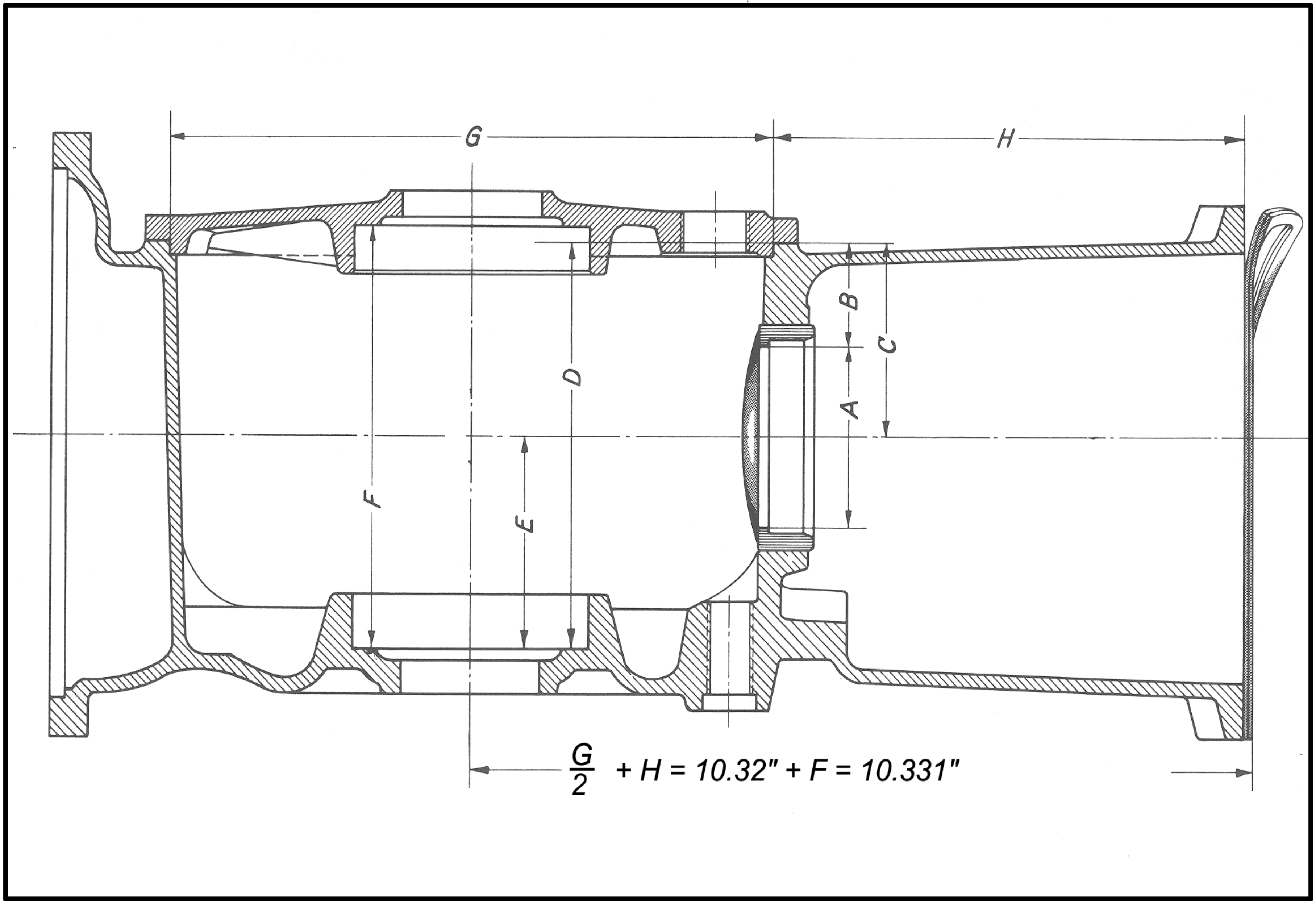
Owing to assembling difficulties, the 3rd and 4th gear wheels of the drive shaft are not replaceable. Therefore it is only possible to replace the complete drive shaft.

1. Before fitting the drive shaft into the base plate, first press the ball bearing 6304 C 3 and the angle ball bearing outside ring into the base plate.
2. Press the base plate with ball bearing onto the drive shaft.
3. Fit the main shaft into the base plate with the second ball bearing inside ring.
4. Screw both nuts onto both shafts, but only hand tight.
5. Place the base plate into a bench vice and tighten between aluminum alloy jaws.
6. Place the two pressure pins into the base plate.

   IMPORTANT

   The gear shift fingers of the selector rods for the reverse, 3rd and 4th gears are in appearance nearly the same, but are stamped with a "0", "1" and "2". These numbers must face outwards, see figure 2.

7. Position both selector forks with the longer boss side facing the base plate into the grooves of the sliding rings.


G
H
A
B
C
D
E
F
$\frac{G}{2}$ + H = 10.32" + F = 10.331"

8. Push the selector rods for the 3rd and 4th gears into the base plate until the neutral position. Also the 1st and 2nd gear selector rods.

9. Insert the expanding pins into the selector forks and selector rods, but when tapping these into position with a hammer, support the rods to avoid bending.

10. Insert both springs and balls of the gear interlock into the base plate, and finally screw in both plug screws with new gasket washers.

IMPORTANT

If new parts have been used for the gear shift mechanism, such as 1st and 2nd, 3rd and 4th gear selector forks, selector rods or gear shift fingers, then the measurement from the gear shift finger to the base plate, or for instance from the 4th gear selector fork to the base plate should measure 0,406" (10,3 mm).

Check that all nuts are tight and locked with new split pins.

DIFFERENTIAL - DISMANTLING AND ASSEMBLING

1. Use a puller to remove both ball bearings 6208 C 3 from both ends of the differential.
2. Unscrew the 8 hexagon bolts and remove the crOWn wheel from the differential case.
3. Remove the 5 mm diameter expanding pin from the differential pinion shaft and drive shaft out in the direction of the expanding pin hole.

NOTE: The differential pinion shaft is 0,002" (0,05 mm) larger in diameter at the expanding pin end.

4. Remove pinion gears, side pinions and thrust washers from the case.

ATTENTION

Mark the gears with paint when removing so that when refitting they will return to their original position.

Check all parts for damage or wear, renew any damaged part.

The assembling is in the reverse order, but the following points must be considered.

1. The side pinions must have an axial clearance of 0,008" - 0,02" (0,2 to 0,5 mm). This clearance can be obtained by fitting different thickness of thrust washers.
2. The harden faces marked with an "A" must bear on the side pinion.
3. Fit the side pinions with the steel thrust washers, place the pinion gears in the case opening, and in this position align the holes of the pinion gears and turn the pinion 90° and push the bronze thrust washers under. At the same time raise the top side pinion and insert the pinion shaft in the case and finally refit the expanding pin.

The ball bearings 6208 must have the fitting mark 3, and it is necessary to press the bearings onto the differential case before assembling in the gearbox housing.

Fit the crown wheel and fit the locking plates, tightening the bolts to 43.4 - 50.5 ft. lb. torque, relock the locking plates.

REFITTING AND ADJUSTING THE DIFFERENTIAL, FIGURE 1.

Should the main shaft, crown wheel or gearbox casing be renewed, then the following points must be carried out.

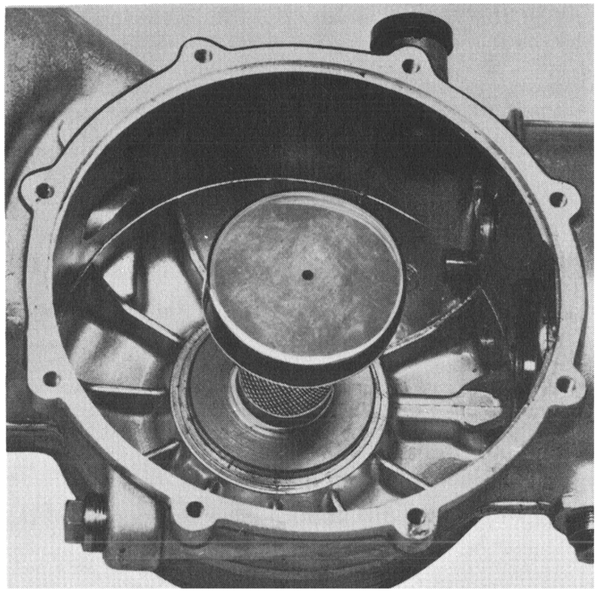
Before fitting the differential the height adjustment of the crown wheel (tooth clearance) must be checked in the following manner:

Measurement "E" from the main shaft centre to the ball bearing seating in the case is obtained as follows:

"A" is the inside diameter of the ball bearing outside ring.

"B" is the distance from the roller bearing outside ring to the differential cover face of case.

"D" is the measurement from the ball bearing seating face to the differential cover surface.



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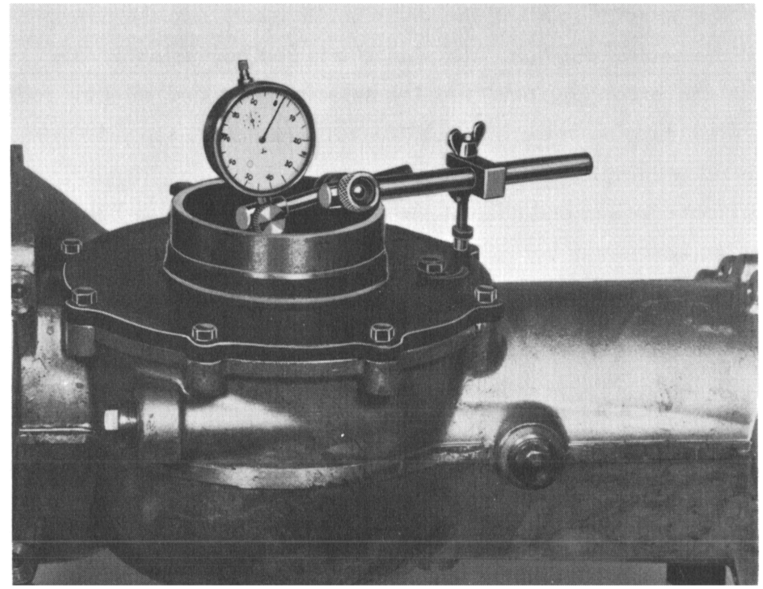

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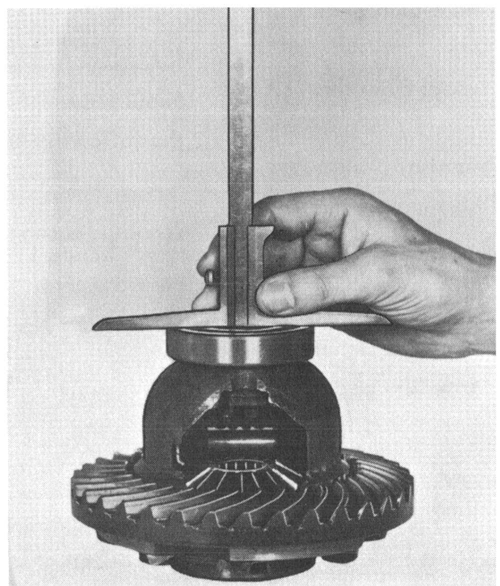

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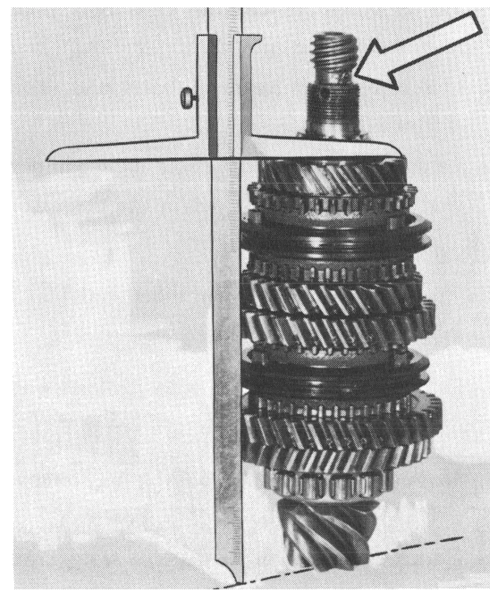

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EXAMPLE

Mentioned are the measurements:

"A" = 2,256" (57,3 mm)

"B" = 1,311" (33,3 mm)

"D" = 5,126" (130,2 mm)

Then determinate measurement "C"

A/2+ B = 2,256" (57,3 mm) / 2 + 1,311" (33,3 mm) + 2,439" (61,95 mm)

Then is "E" = "D" - "C" also "E" = 5,126" (130,2 mm) - 2,439" (61,95 mm) = 2,687" (68,25 mm).

As one can see from these measurements, the distance "E" (from main shaft centre to ball bearing seating face) should be 2,677" (68,0 mm), If it should read 2,687" (68,25 mm) then the difference must be corrected with a shim washer from the thickness of 0,01" (0,25 mm) being placed under the ball bearing.

Before refitting the differential the measurement "F" must be checked between the ball bearing seating face and that of the opposite in the cover, checked with the shim washer placed in position.

This last measurement is important to obtain the differential clearance, taking into account the axial clearance of 0,004" (0,10 mm) at the cover.

Push the plug gauge AC 38 into the ball bearing seating. Then fit the cover with one gasket and with a control measuring clock measure the difference by lowering or raising the plug gauge, see figure 1 and 2.

After pressing the ball bearings onto the differential measure the whole length, figure 3 and 4.

Measurement "F" minus the length of the differential case must be 0,004" (0,1 mm) .

EXAMPLE

Measurement "F" (example)	5,357"	(136,05 mm)
Minus the length of differential case	5,345"	(135,75 mm)
Remainder clearance	0,012"	(0,30 mm)

Owing to the clearance being only 0,004" (0,1 mm) it is necessary to place a packing shim 0,008" (0,20 mm) thick between cover and ball bearing.

After the height of the crown wheel and also axial clearance of the differential have been made with the aid of shims, it is still important to measure the axial clearance of the main shaft.

This adjustment of the main shaft can be made by placing gaskets of different thicknesses between gearbox and base plate.

The control measurement of 10,331" (262,4 mm) is the measurement from the middle of the differential to the face of the base plate, including gaskets.

The measurement of the main shaft is engraved between the thread end of speedo-drive worm, near the running pair number, figure 5.

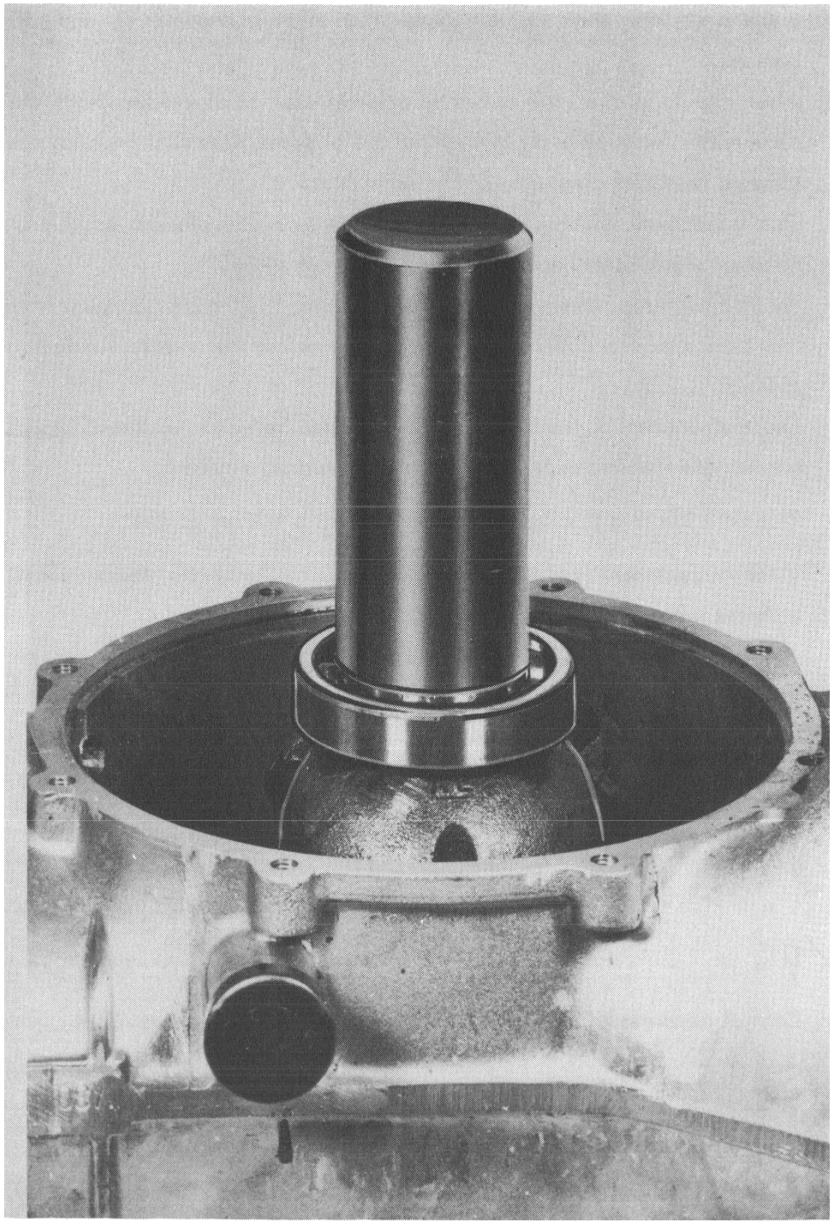
Plus mark means a thicker, minus mark means a thinner gasket.

If the measurement is plus, then one must add to the control measurement, or minus subtract.

EXAMPLE TO MEASURE THE CORRECT GASKET THICKNESS

Measurement G (example)		8,079"	(205,2 mm)
Measurement H (example)		6,28"	(159,5 mm)
Measurement of the main shaft		+ 0,005"	(+0,12 mm)
G/2 = 8,079" (205,2 mm) / 2	=	4,04"	(102,6 mm)
+ H	=	6,28"	(159,5 mm)
G/2+H	=	10.32"	(262,1 mm)
Control measurement		10.331"	(262,4 mm)
-G/2 + H	=	10.32"	(262,1 mm)
Gasket thickness =	J =	0,011"	(0,3 mm)

The measurement + 0,005" (0,12 mm) must be taken into account. Then the final thickness of the gasket would be 0,016" (0,42 mm).



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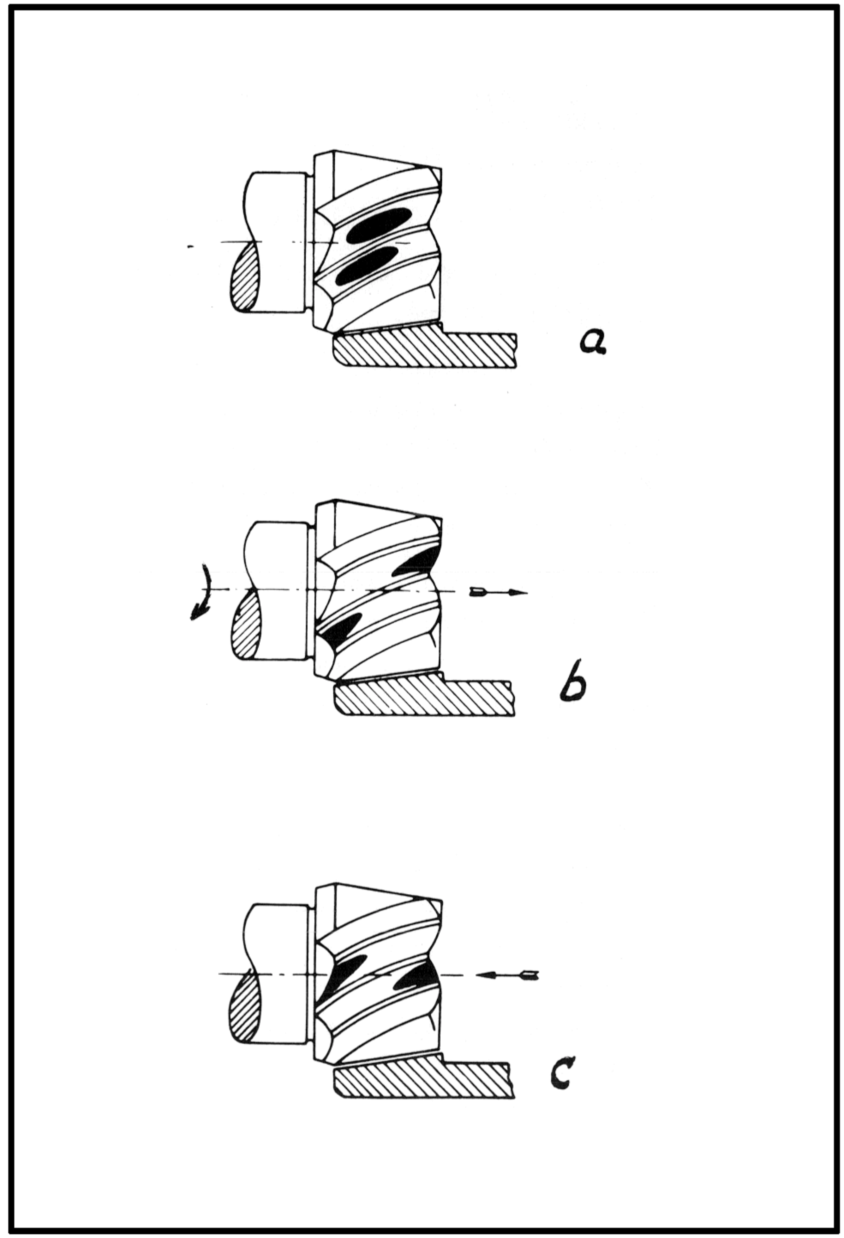

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The correct fitting is easy to check, when a parallel end gauge is inserted between the main shaft spur gear and differential case, the parallel measurement is the correct thickness, when the zero measurement 0,374" (9,5 mm) is engraved on the main shaft in the near of the speedometer drive worm.

EXAMPLE: + plus or - minus.

After all the correct thickness of gaskets and shims has been made, the assembling can begin. Fit the differential into the gearbox with the distance shim placed in position. Use the special tool AC 35 to drive it into its end position, figure 1.

Place the correct gasket or gaskets, which ever the case may be, between gearbox face and base plate. Insert the dowel pins into the base plate and tap into position.

To prevent the drive shaft oil seal from getting damaged, use the special sleeve AC 29.

IMPORTANT

When fitting the base plate with unit to the gearbox, care must be taken for there are four points that can cause a resistance. DON'T USE FORCE, but take notice of the following hints.

1. Slightly raise the reverse gear selector rod when inserting it into the base plate.
2. The remaining selector rods must be inserted into their respective bores in the gearbox. This is best carried out by tilting the base plate.
3. When inserting the roller bearing inside ring into its outside ring, take great care. Otherwise the rollers will tilt.
4. The last cause of resistance could be the meshing of the crown wheel and main shaft teeth, especially if the tooth clearance should be small.

After the base plate with unit have been fitted in the gearbox case, tighten both the main and transmission shaft castellated nuts with the reverse and 4th gear in mesh. Should the main shaft have two split pin holes then tighten nut to 87 ft. lb. torque. Finally insert split pins in both nuts.

Fit the reverse gear selector finger onto selector rod.

NOTE: The stamped "2" must face outwards to the water transmission box.

Insert the selector rod locating ball and spring and finally screw the plug screw with gasket ring into position.

Fit the cover freely with gasket, which must be 0,008" (0,20 mm) thick. To obtain the correct contact reflection of the crown wheel and main shaft spur gear teeth, smear a thin coat of engineers marking blue onto the crown wheel teeth. Figure 2a: good. Figure 2b: Fit thinner gasket. Figure 2c: Fit thicker gasket.

Place the differential cover gasket in position smeared with a little grease to stop them from moving. Then tighten the 8 hexagon bolts to 18.0 - 21.6 ft./lbs. torque; the name HERMES must always be at the top.

Before measuring the tooth flank clearance the differential must be tapped towards the opposite side of the cover.

Now measure the tooth flank clearance with the special tool AC 37, but while measuring hold the main shaft with a screwdriver to prevent it from turning.

The tooth flank clearance must be checked at four different positions of the crown wheel. Allowed untrue running of crown wheel 0,003" (0,07 mm). The tooth flank clearance must be 0,006" - 0,01" (0,15 to 0,25 mm). Should the clearance be other than above, and then this can be adjusted by placing shims of different thickness between differential and gearbox housing, top and bottom.

To obtain a better picture of the teeth flank, turn the crown wheel several times in both directions. Unscrew the differential cover bolts and check the tooth flank picture.

If an alteration is necessary then this can be adjusted by altering the gasket thickness between the base plate and gearbox housing.

If the tooth flank shows a correct picture, then the differential must be tapped in the direction of the case, using the special tool AC 35 before refitting the cover. After fitting and tightening the cover, it is recommended once again to check the tooth flank picture.

Refit drain plugs.

Refit the clutch release lever and graphite ring.

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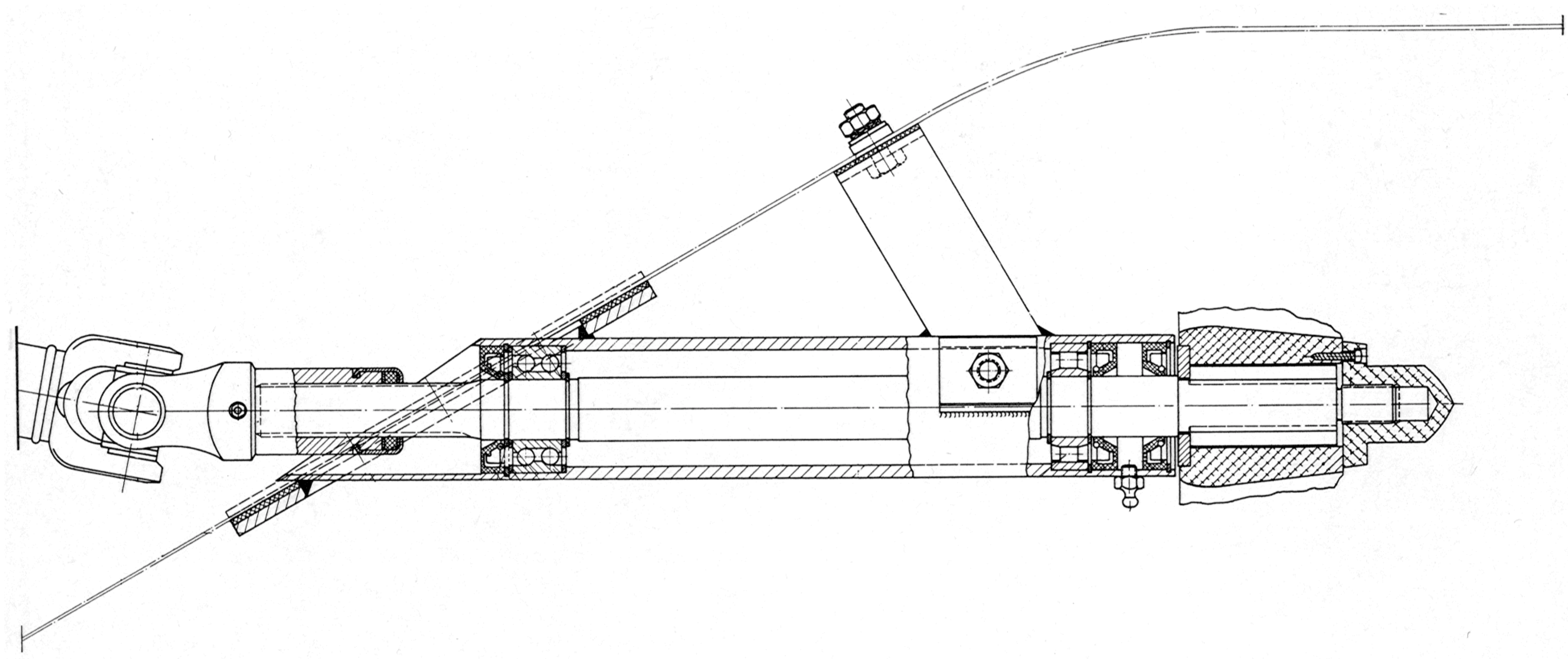

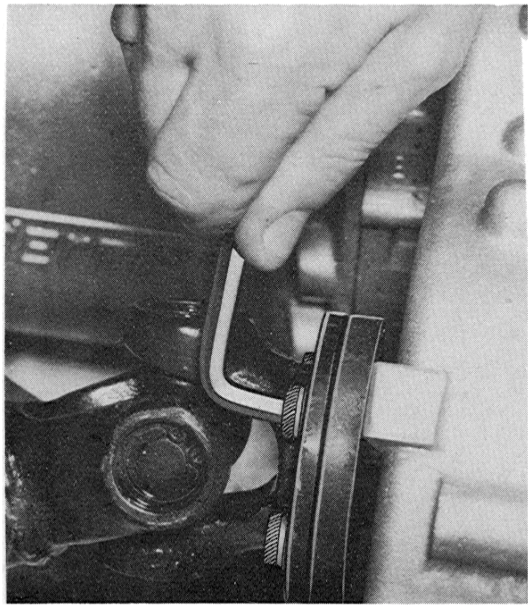
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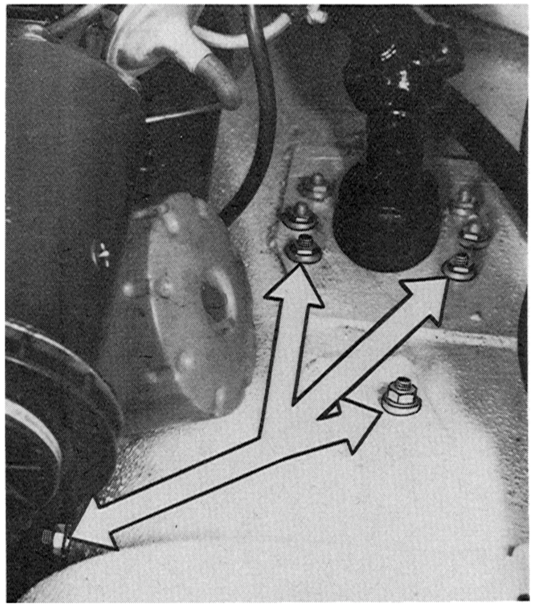
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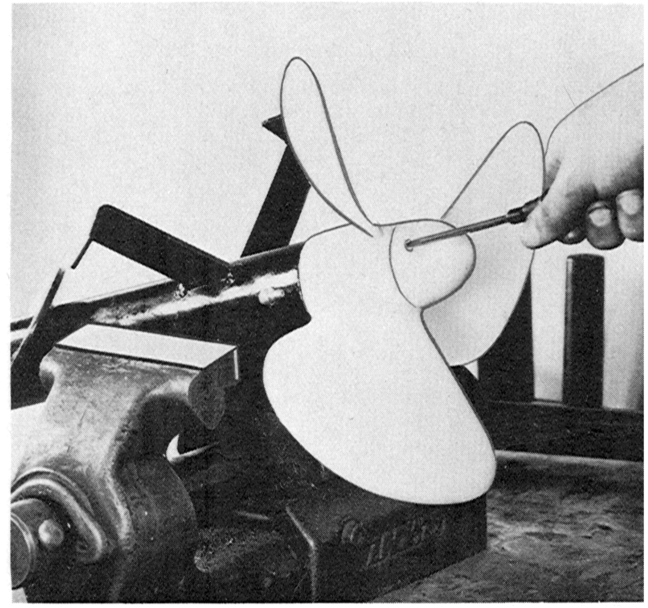
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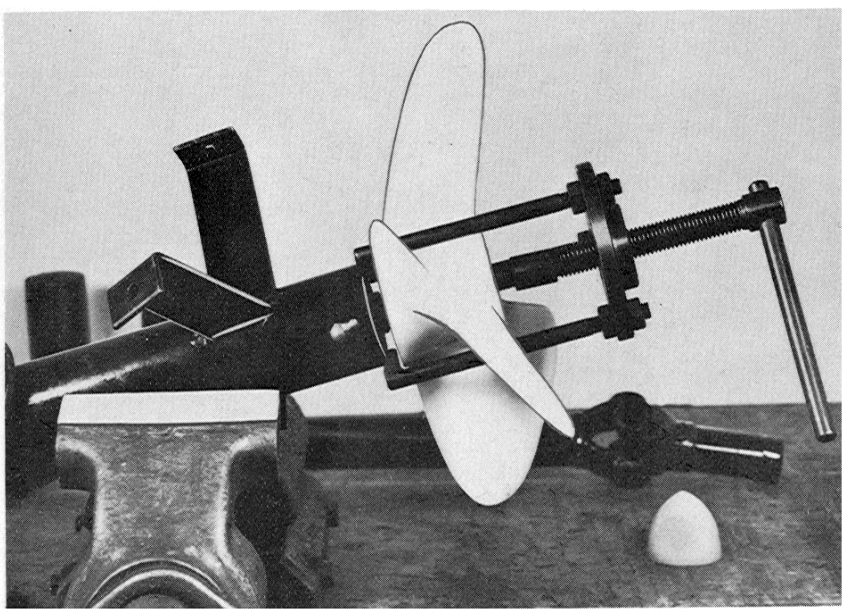
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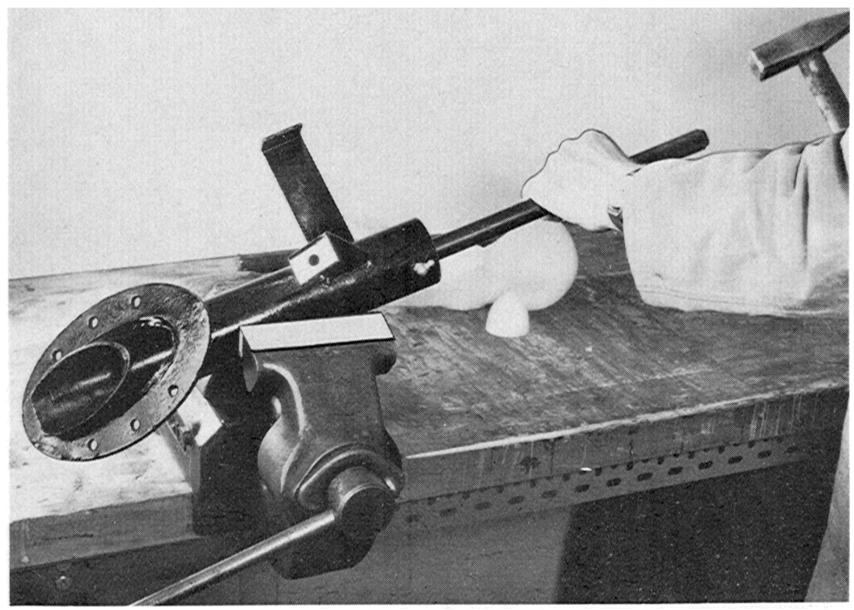
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PROPELLER DRIVING UNIT

The propeller drive is driven from the water transmission gearbox, over the left and right mounted universal joint shafts, drive shafts and finally to the propellers.

REMOVING THE UNIVERSAL JOINT SHAFTS

Unscrew the four fastening screws from the shaft flange as shown in figure 1 from the gearbox, and remove shafts.

REMOVING AND REPAIRING OF THE PROPELLER DRIVING UNIT

1. Unscrew and remove the eight hexagon bolts with Dubo locking rings and disc washers, using a 14 mm wrench as shown in figure 2, and then draw the complete propeller shaft housing away together with oval gasket from the bilge.
2. After cleaning, place the complete housing in a bench vice clamping between light metal jaws, to avoid damaging.
3. Unscrew the small set screw in the cap nut, see figure 3, before removing nut, and by using the special tool AC 25 draw the propeller off from the shaft, see figure 4.
4. Remove both keys from shaft, grease nipple, locking ring, and then radial oil seals from housing.
5. Using a bronze or light metal drift, drive the shaft out of the housing in the direction of the propeller.

IMPORTANT

While driving the shaft out, turn the shaft with one hand to avoid the locking ring of the roller bearing inside ring from sitting behind the rollers, and therefore preventing damaging the roller bearing.

6. Remove the roller bearing inside ring from the shaft, and from the housing remove the roller bearing outside ring and taper ball bearing, see figure 5.

   Clean all parts, and check for wear and damage.

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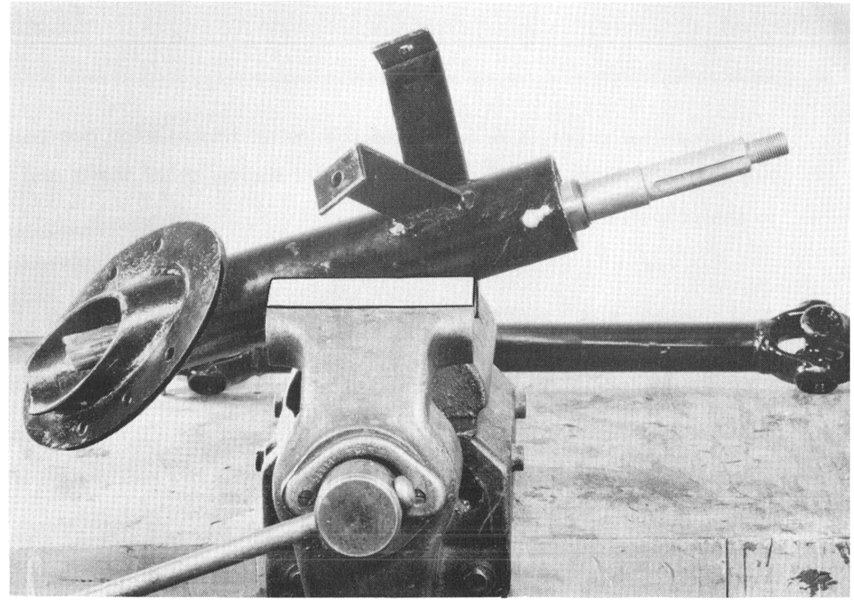

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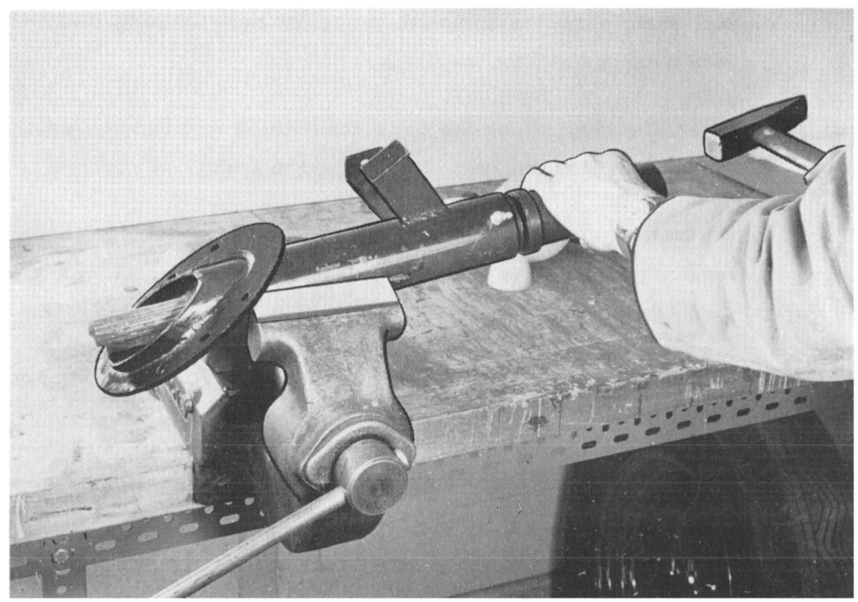

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ASSEMBLING

1. Fit the locking ring and use the special tool AC 28 for fitting the roller bearing inside ring on the shaft at the propeller end, figure 1.
2. Clamp the shaft in a bench vice, and fit the following parts on the splined end of shaft:
   a. Locking ring.
   b. Snug fit washer.
   c. Taper ball bearing.
   d. Snug fit washer.
   e. Locking ring.

   Place the shaft in a position free from dust until fitting.
3. Clamp the housing in a bench vice between light metal jaws, and fit the snug fit washer into the bore at the flange end of housing. Now take the already assembled shaft and fit into the housing inserting from the flange end and drive to the propeller direction, figure 2. Fit snug fit washer and locking ring.
4. Using a long connection pipe attached to a hydraulic greasing unit, fill the housing with multi-purpose grease, until it comes through the ball bearing.
5. Fit the roller bearing outside ring using special tool AC 26, and the locking ring.
6. Remove and clean all surplus grease from both ends of housing, and using special tool AC 26 together with AC 27 fit the radial oil seal, figure 3.
7. Fit locking ring into housing at the propeller end.

ATTENTION

At the propeller end of the housing are two radial oil seals fitted in the following way:

a. The inside radial oil seal lip must face to the inside of the housing.

b. Radial oil seal lip must face to the outside of the housing.

8. Fit locking ring.

   At the splined end of the shaft, the oil seal lip must face to the inside of the housing.
9. Fit the grease nipple and grease. This will fill the room between both radial oil seals.
10. Fit both keys in the shaft, then propeller with cap nut.

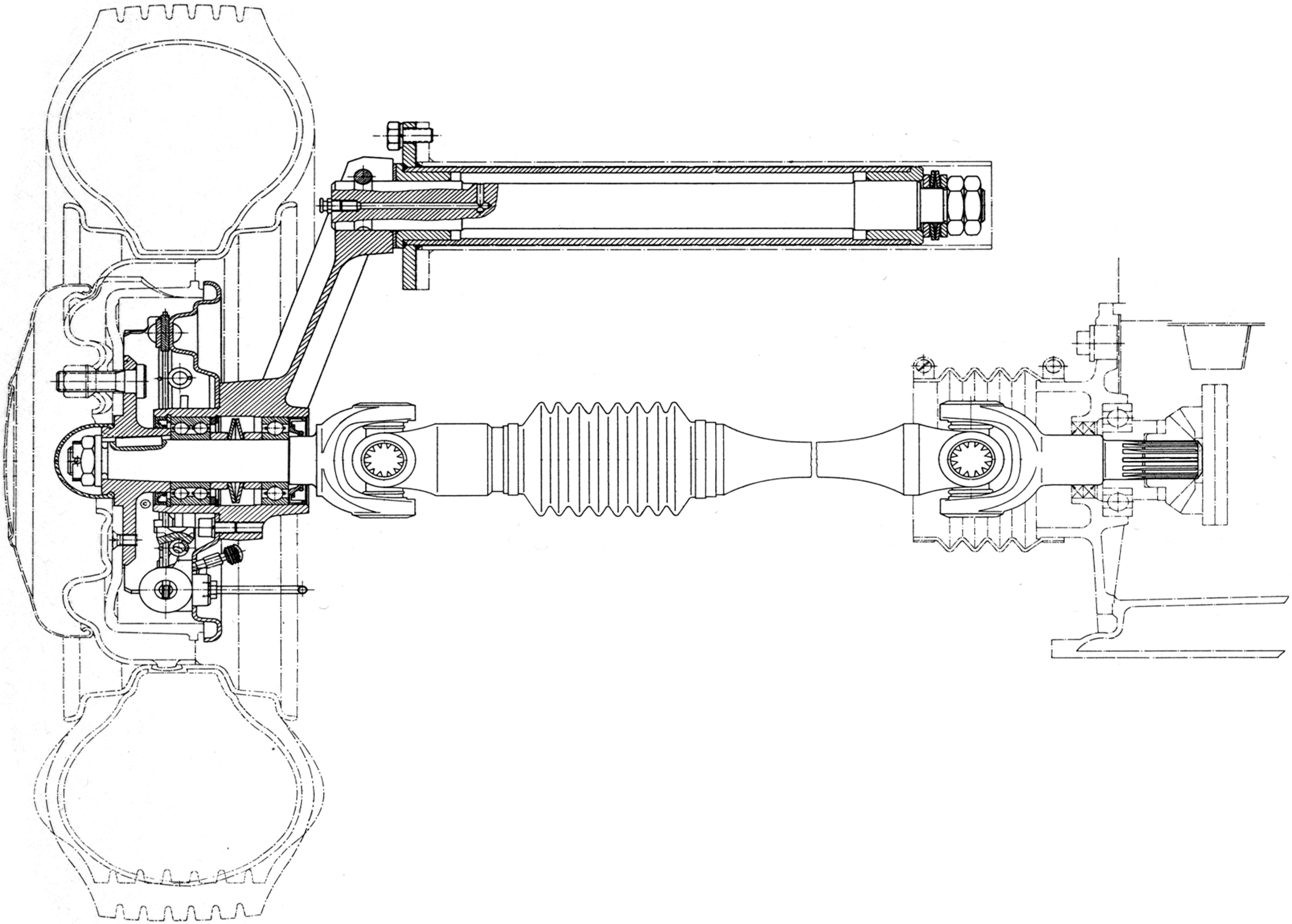
NOTE

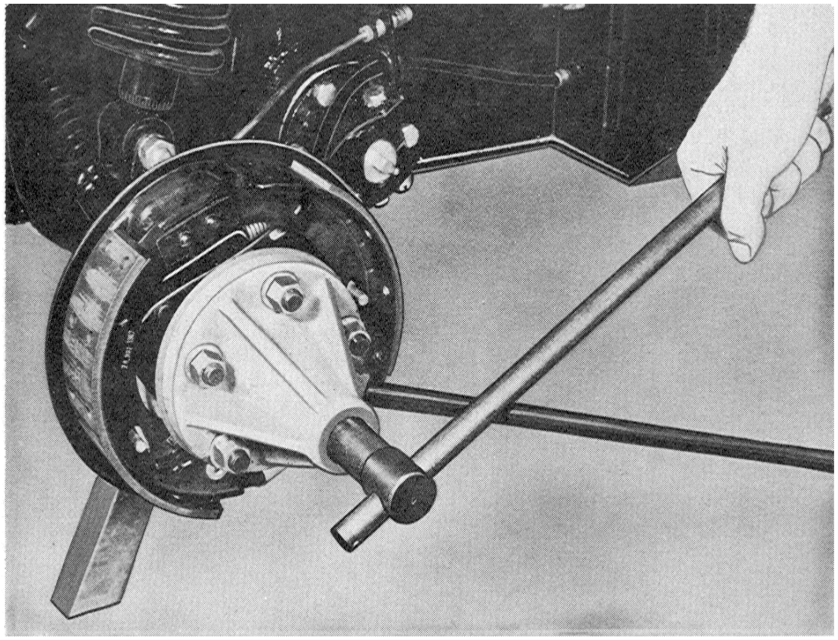
To lock the cap nut after final tightening, bore a hole with a 0,098" (2,5 mm) diameter drill through the cap nut into the propeller, and then screw the fillister head screw into position.

The propeller driving unit is now completely re-assembled and ready for refitting into the vehicle, but always re-new oval gasket and Dubo locking rings.

IMPORTANT

Always grease with branded multi-purpose grease. On no account should track roller grease be used.

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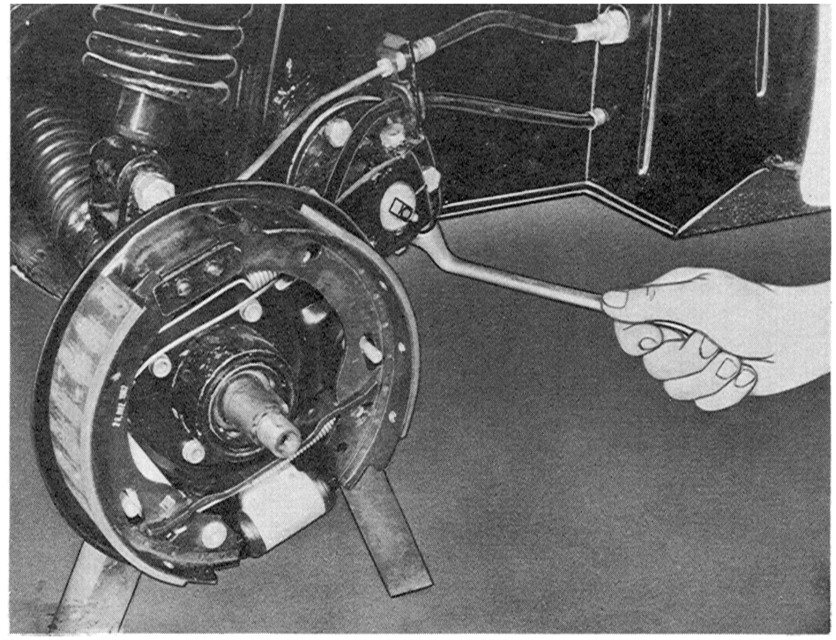
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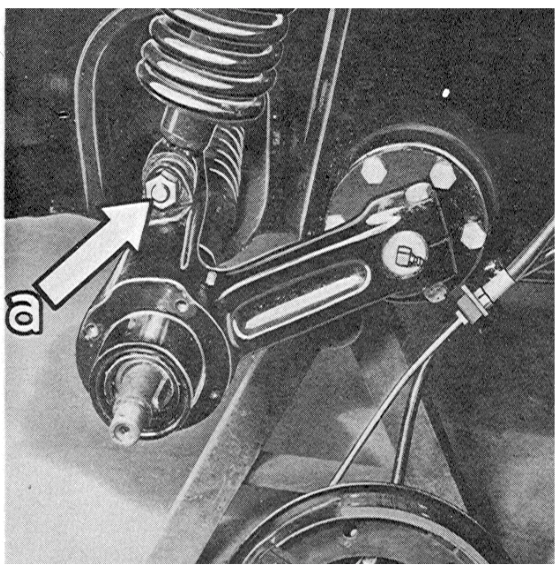

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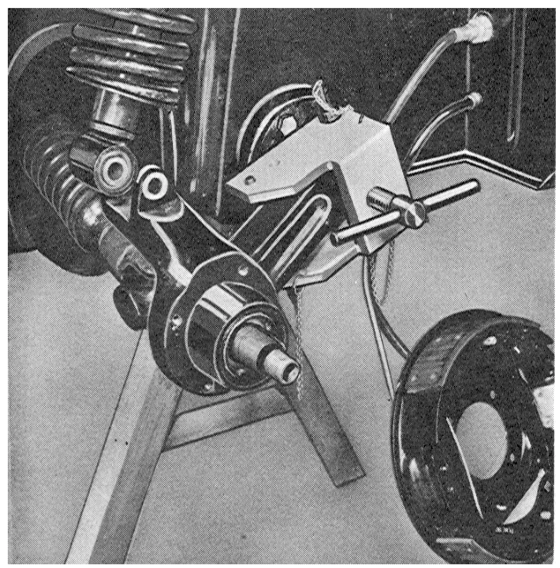
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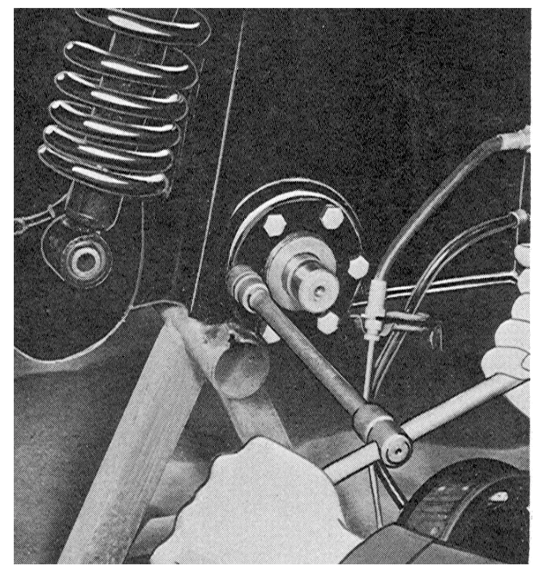
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REAR AXLE - UNIVERSAL JOINTS AND SUSPENSION

DESCRIPTION

The rear wheels are mounted on oscillating arms, with fully independent coil spring suspension, and double acting hydraulic telescopic shock absorbers.

The engine power is transmitted to the independently suspended rear wheels, and the varying differences in level during the drive between the wheel centre and the differential is compensated by the two universal joints.

The splines of the shaft enable a shifting in the axial direction, effecting a compensation of differences in length caused by the spring action while driving. Also the drive shaft is divided into, two halves enabling a movement in the axial direction, being protected from water and dirt by rubber bellows. The drive shaft is mounted on the left and right side into the oscillating arm and gearbox. Also the double acting hydraulic telescopic shock absorber is bolted to the oscillating arm, and the brake drum is fastened with three countersunk screws to the wheel hub.

REMOVING THE REAR AXLE

1. Remove the rear wheel hub caps, and slacken off the wheel nuts, before raising the vehicle as described on page 1/9, figure 1 and 2.
2. Remove the three brake drum fastening screws, page 2/1, figure 1, and remove the brake drum, making sure beforehand that the hand brake is not at the "on" position.
3. Remove the rubber protection cap, and the castellated nut split pin. Unscrew castellated nut.
4. Use the special tool AC 14 to remove the wheel hub as shown on figure 1.
5. Unscrew and remove the oscillating arm clamping bolt, see figure 2.
6. Unscrew the four allen fastening screws from the brake and back plate, and remove anchor plate.

ATTENTION

After removing the brake anchor plate, take care in placing it to one side and supporting it to avoid strain or damage to the fitted brake hose and cable, figure 3.

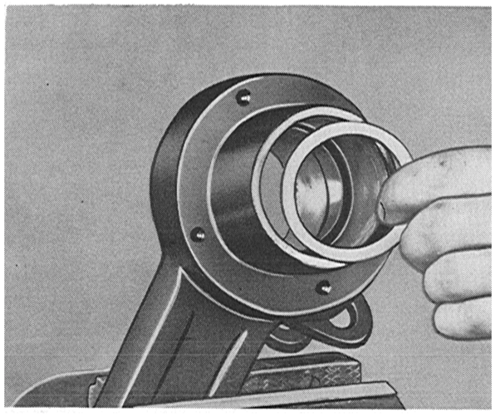
7. Unscrew and remove the coil spring bottom fastening bolt, figure 3 a.
8. Use the special tool AC 16 to remove the oscillating arm, see figure 4.
9. Draw the drive shaft out' of the gearbox splined bore.

ATTENTION

When drawing the drive shaft out, take care to support the shaft as near as possible at the gearbox end with one hand to prevent damaging the rubber bellows, and to avoid the possibility of the drive shaft from being parted in the middle.

REMOVING AXLE HOUSING WITH AXLE

1. Remove the buffer disc, and unscrew the six hexagon fastening bolts from the axle housing flange, and draw the complete unit out of the vehicle, see figure 5.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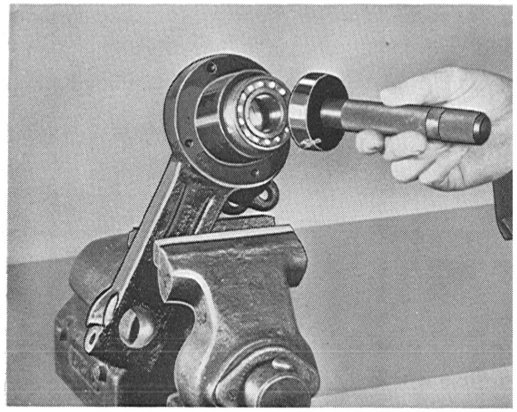
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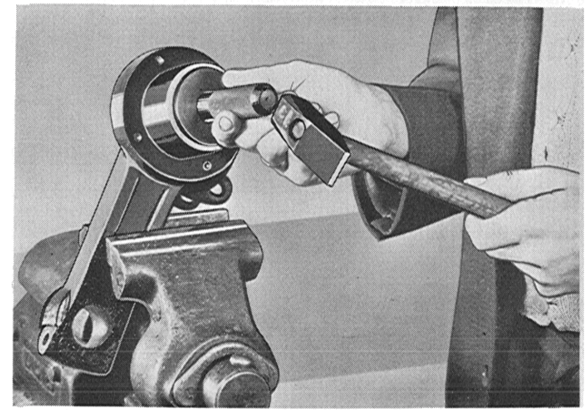
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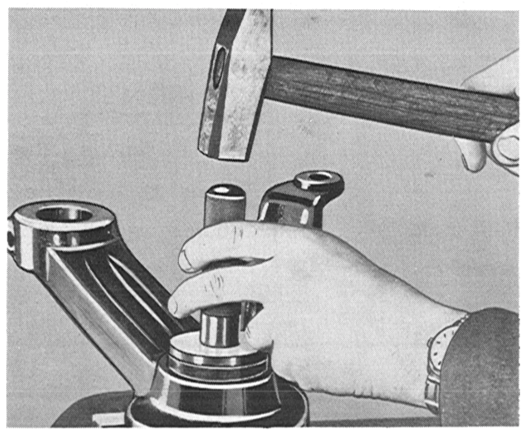
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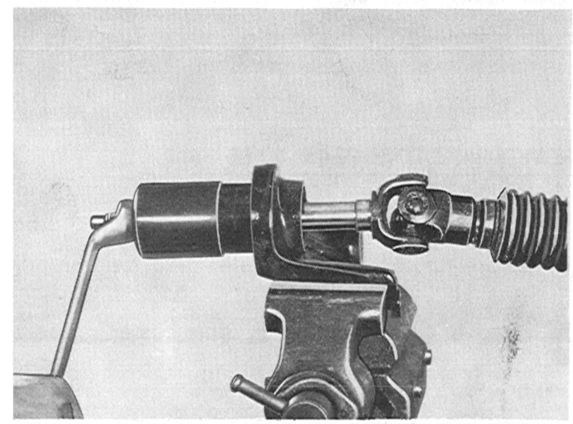
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DISMANTLING THE OSCILLATING ARM,

RECONDITIONING AND ASSEMBLING

Dismantling in the following order.

1. Place the oscillating arm after thoroughly cleaning in a bench vice, and by using a bronze drift drive the shaft out.

   ATTENTION

   Care must be given to avoid damaging the thread of the shaft.

2. Remove from both ends of the oscillating arm bore the radial oil seals and locking ring.
3. Remove the taper bearing by light crosswise tapping, driving out from the inside to the outside. Remove ring, distance bushing, and both disc washers.

   Thoroughly clean and carefully check all removed parts for wear and damage. Replace if necessary.

ASSEMBLING

1. Fit the inside locking ring together with plain ring in the bore, see figure 1.
2. Well grease the taper bearing, and using the special tool AC 9 drive the bearing into its correct position. Refit the outer locking ring, figure 2.
3. Using the special tool AC 12 together with AC 32 fit a new radial oil seal, figure 3.

   ATTENTION

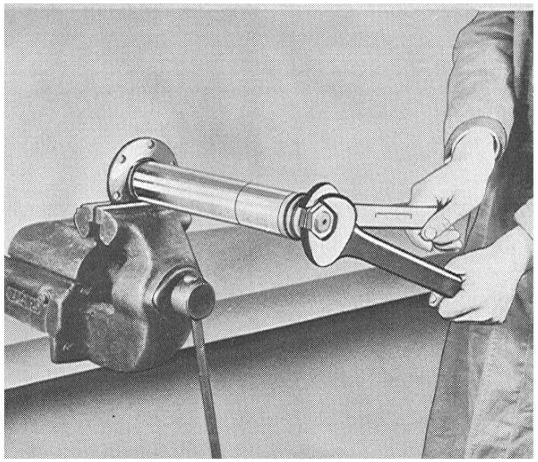
   The radial oil seal lip must face to the outside of the bore, to prevent water from entering the bearings. Always fit new oil seals, never refit the old ones.

4. With the oscillating arm still mounted in the bench vice fit as shown in figure 4 both distance bushings and both buffer discs.
5. Use the special tool AC 9 to fit the grooved ball bearing, and AC 11 together with AC 32 to fit the radial oil seal, figure 5.

   ATTENTION

   The radial oil seal lip must face to the outside of the bore.

6. When fitting the drive shaft into the bearings with the special tool AC 13, figure 6, the following points must be followed:
   a. Push the drive shaft end into the bearings, and then screw the threaded spindle of the special tool AC 13 onto the threaded end of the drive shaft.
   b. Place the special tool bell form over the threaded spindle with plain washer and hexagon nut, and by tightening the nut, the drive shaft will be drawn into its correct end position.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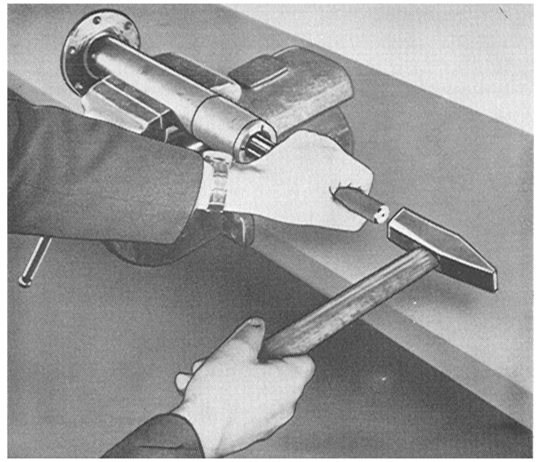
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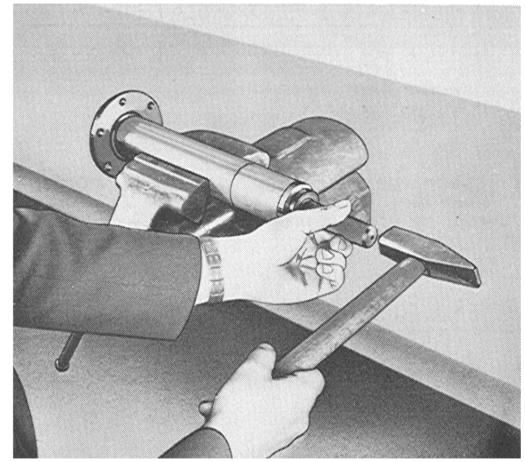
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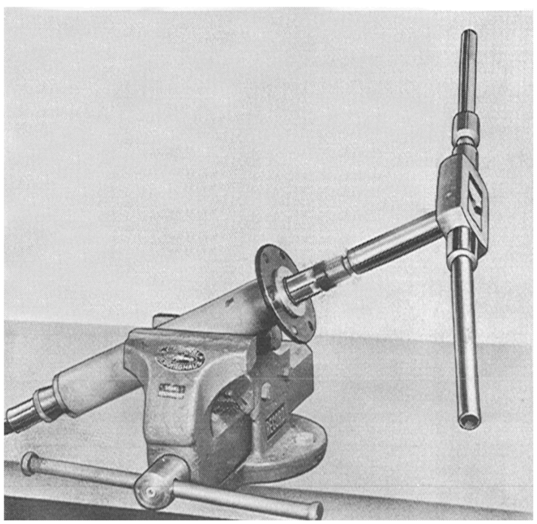
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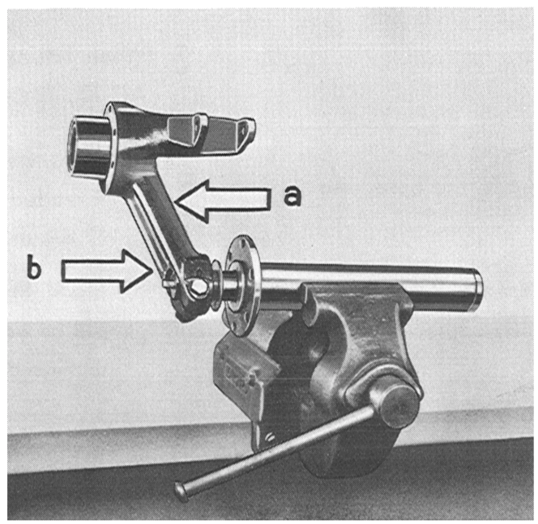

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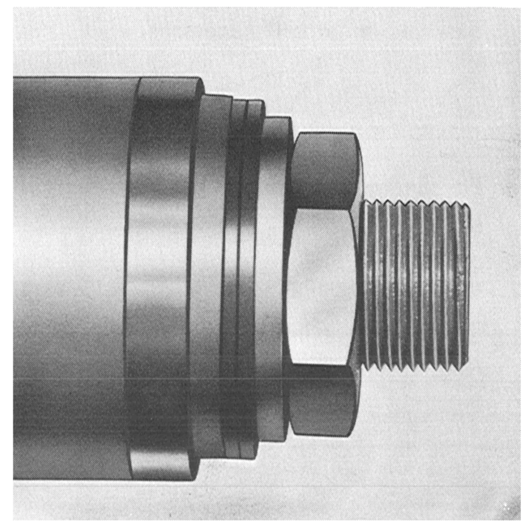
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DISMANTLING THE AXLE HOUSING,

RECONDITIONING AND ASSEMBLING

Dismantling in the following order.

1. Tighten the axle housing in a bench vice clamping between light metal jaws, and using the special wrenches AC 20, slacken and remove both hexagon nuts, buffer discs, disc washers and plain washer, figure 1.

   Then by using a plastic or rubber hammer drive the axle to the flange direction out.

2. Using the special tool AC 17 drive the bearing bushing out of the housing, figure 2.

NOTE: Should after cleaning a heavy wear be found, then new bearing bushings must be fitted.

3. Fit new bearing bushings by using the special tool AC 18, figure 3. Then by using the special adjustable reamer, ream the bushings, after which the axle can be fitted.

   ATTENTION: FIGURE 4.

   When reaming the bushings always turn the reamer clockwise, thus avoiding damage to the cutting edge. Never when removing the reamer from the bushings should it be turned to the left.

   The axle when fitted should have a play from 0.001" (0,03 mm). That means the axle must turn with the assurance that it does not seize owing to a minimum lubrication area.

4. Fill the axle housing with Multi-purpose grease, before fitting the axle.

5. Place the buffer disc onto the axle at the flange end, and fit the oscillating arm, but paying attention that the parts are clean, and free from rust or dirt, which would make the assembling difficult.

6. Insert the oscillating arm clamping bolt, but only turn the nut to finger tightness, figure 5, and push the oscillating arm as far as possible against the buffer disc. Then fit the buffer disc, both disc washers, and buffer disc with hexagon nut and finally tighten.

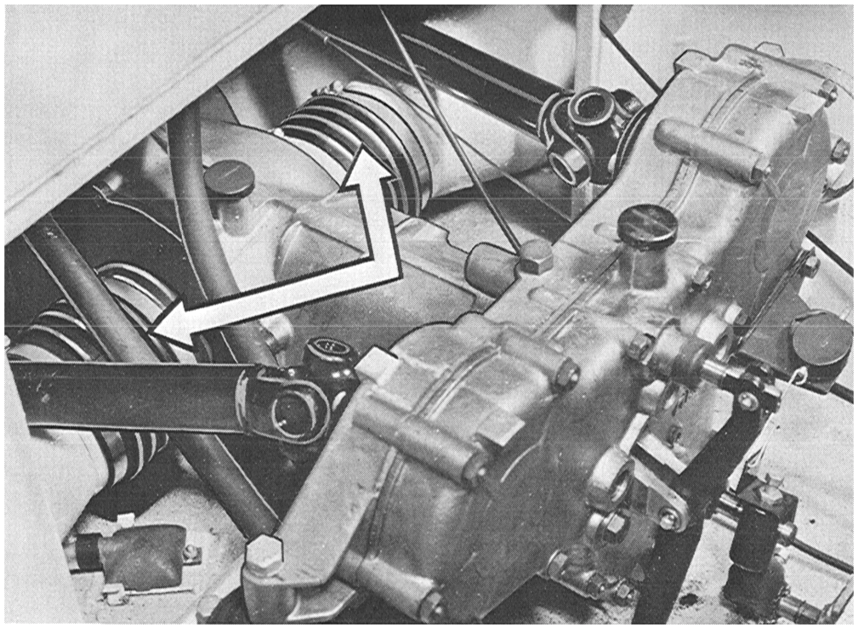
7. By light tapping on the oscillating arm, figure 5a, the clamping bolt will then fit correctly into the axle recess. Finally tighten clamping bolt and adjusting nut.

ATTENTION

To obtain the correct axle adjustment the adjusting nut must be slackened off, so that both disc washers on the axle are just movable. After this the adjusting nut must be re-tightened, figure 6, to 0,024" (0,6 mm) which is equivalent to approx. 1/3rd of a turn of the nut. Fit the lock nut and tighten with the special tool AC 20.

This adjustment will still remain, even though it should be necessary to remove the oscillating arm from the axle.

After fitting a new axle housing gasket the complete axle unit can be fitted into the vehicle.



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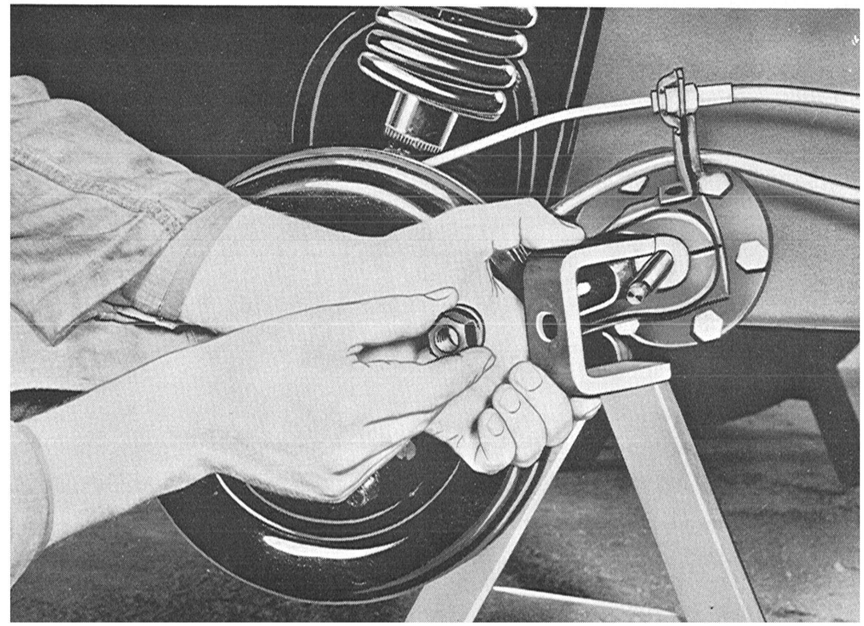

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FITTING THE DRIVE SHAFT AND AXLE HOUSING

When inserting the drive shaft splined end into the gearbox, make sure that the shaft is in the horizontal position, and slightly turn, taking care to avoid damaging the differential radial oil seal.

Should it be difficult to push the splined end into the differential bore, then it is advisable to remove both rubber bellows from the gearbox and chassis tunnel, figure 1. This will enable a better control over the shaft when fitting.

The refitting of the axle unit is in the reverse order, but take note of the following:

It is possible to fit the oscillating arm after the axle housing has been fitted. Use the special tool AC 15/22-2.

Remove the grease nipple from the axle, and screw the threaded spindle of the special tool into the bore, but this must be screwed up to the shoulder of the threaded spindle to avoid the thread from pulling out or from damage.

After fitting the special tool bridge piece AC 15, fit plain washer and hexagon nut. Then by tightening the nut, the oscillating arm will be pulled into position, figure 2.

The oscillating arm bore must be placed exactly onto the axle to avoid it being pulled on oblique. Should it fit very tight then it is advisable to tap the arm with a hammer while pulling into its end position.

ATTENTION

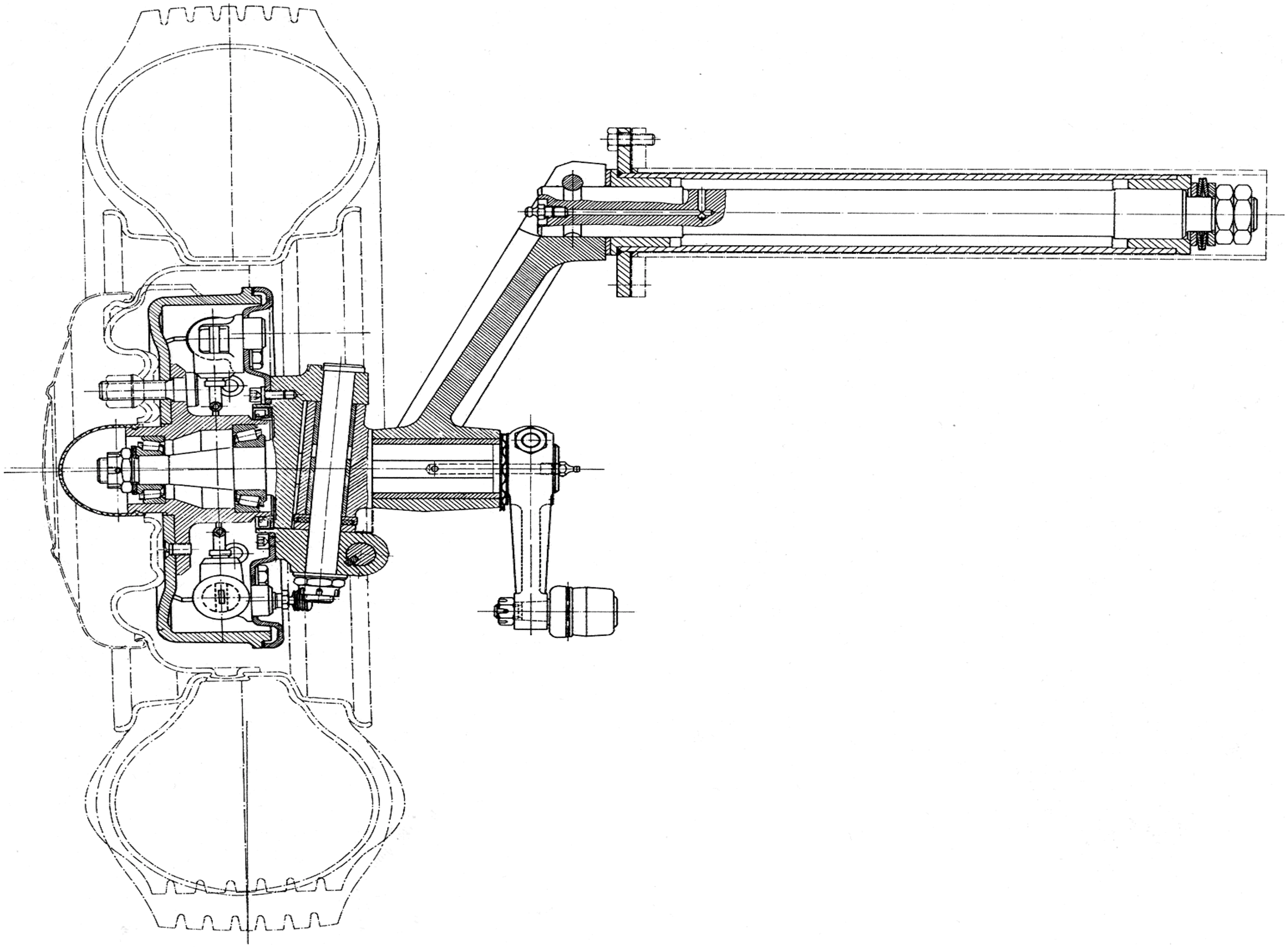
It is most important before and after repair work is carried out, to always check that the axle has the correct play adjustment. This can be corrected by placing shim washers between the axle and oscillating arm, or by removing the complete axle with axle housing and adjusting as described on page 4/7.

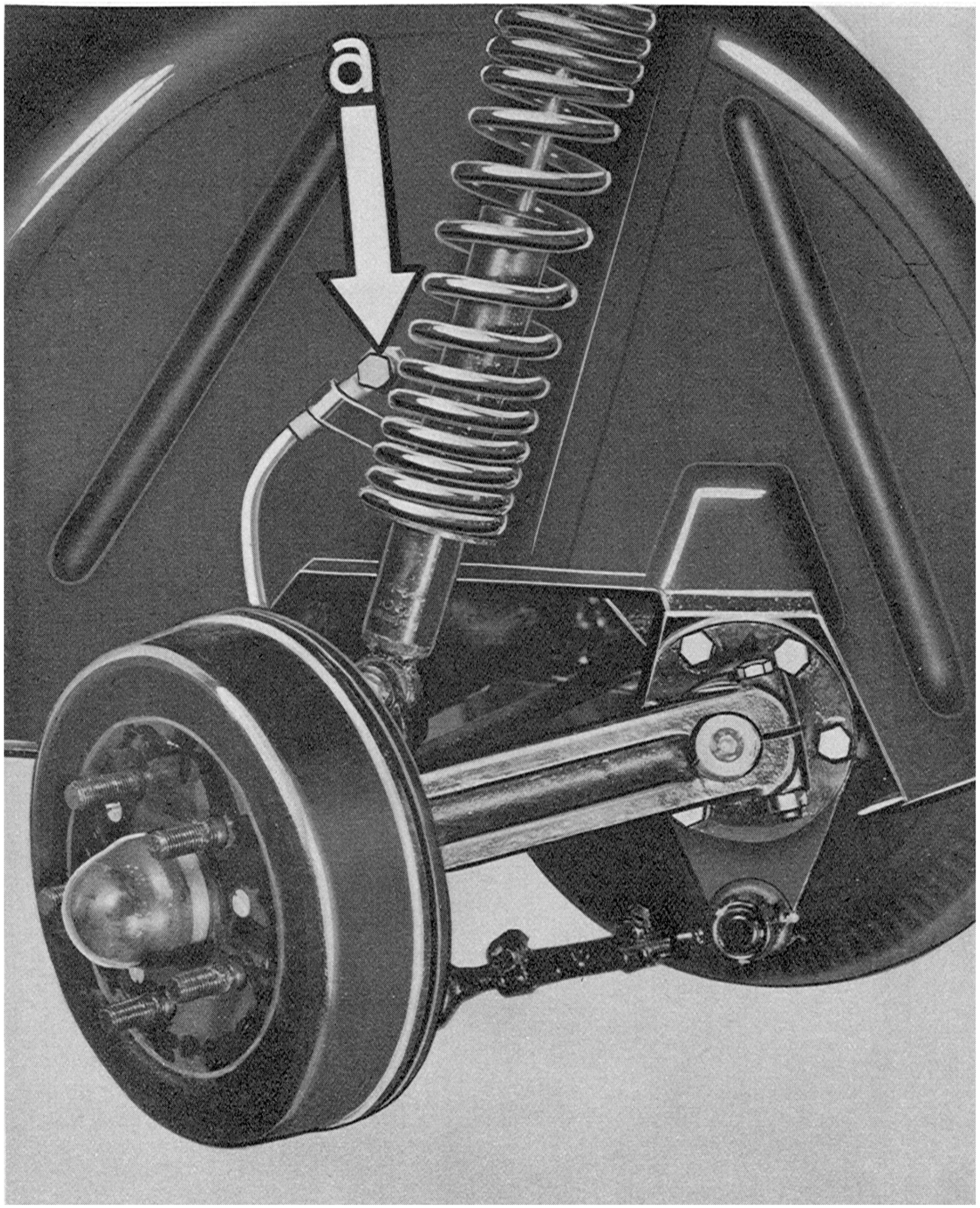
To remove the resilient leg the top and bottom fastening bolts must be removed.

The resilient legs are marked with a paint spot and are paired with the same color markings. If the coil spring or shock absorbers have a defect, either the front or rear, these must always be renewed as a pair.

Special progressive springs have been developed, which form another of the outstanding features of the Amphicar, and are suitable for both fast highway driving and very difficult cross-country conditions.

The resilient legs of the earlier models can be easily modified at an extra cost. Further details covering the execution of the modification will be issued in the Service Department Bulletins.





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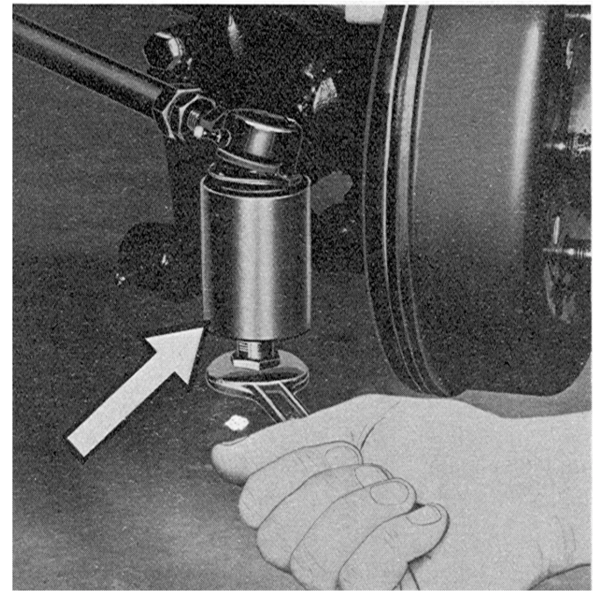

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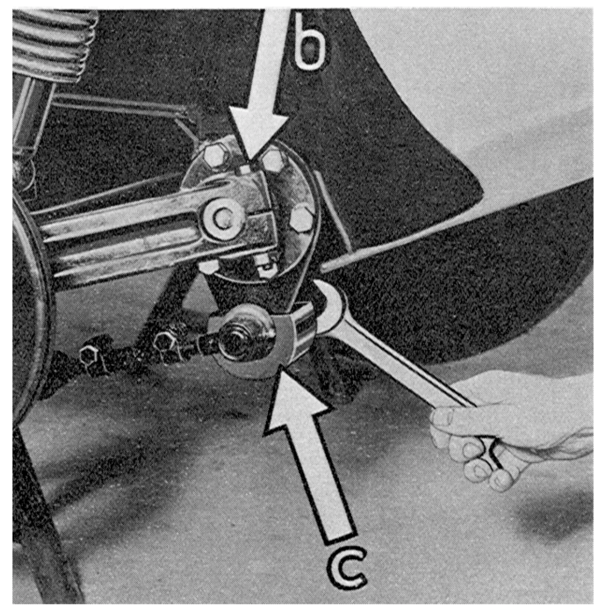

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FRONT AXLE - SUSPENSION AND WHEEL ALIGNMENT

DESCRIPTION

The front wheels are mounted like the rear on oscillating arms with fully independent coil spring suspension combined with double acting hydraulic telescopic shock absorbers.

The spring and shock absorbers assemblies come as one unit connected at the top to the chassis and at the bottom to the oscillating arm.

The oscillating arm is mounted onto the turning axle, thus enabling a swinging movement.

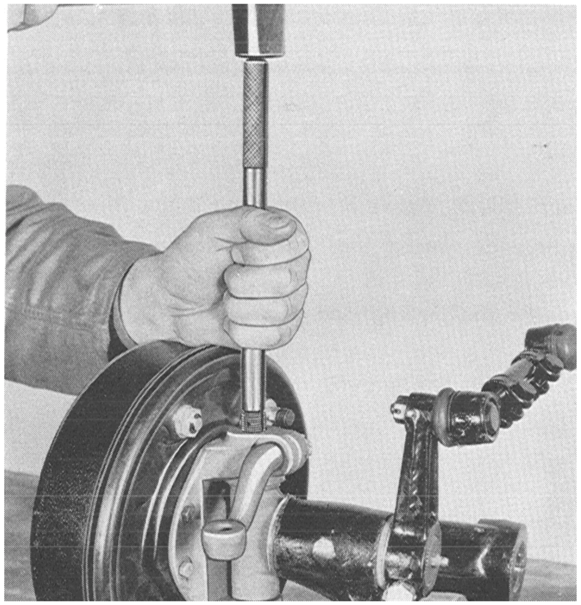
The steering is actuated by a Gemmer worm and roller steering gear, over track rods, knuckles and control arm, the steering tie rod is mounted onto the steering knuckle and is adjustable for the castor alignment.

REMOVING THE COMPLETE FRONT AXLE

1. Remove the front wheel cap, and slacken the wheel nuts before raising the vehicle as described on page 1/8, figure 2.
2. Remove the split pins and hexagon castellated nuts from the track rods, and steering tie rods. Push off the track rod ball joint yoke by using the special tool AC 24 figure 2. And remove the steering tie rod ball joint yoke using the special tool AC 23, figure 3c.
3. Unscrew and remove the oscillating arm clamping bolt, figure 3b.
4. Disconnect the brake hose top union, and plug the hole with a suitable rubber stopper to avoid any unnecessary loss of brake fluid, figure 1a.
5. Unscrew and remove the resilient leg top mounting.
6. Remove the oscillating arm.

AXLE HOUSING REMOVAL

The removal of the axle housing with axle, also complete dismantling and re-assembling is the same procedure as described in Group Rear Axle, page 4/3, figure 5, and page 4/6, figure 1 to 6.



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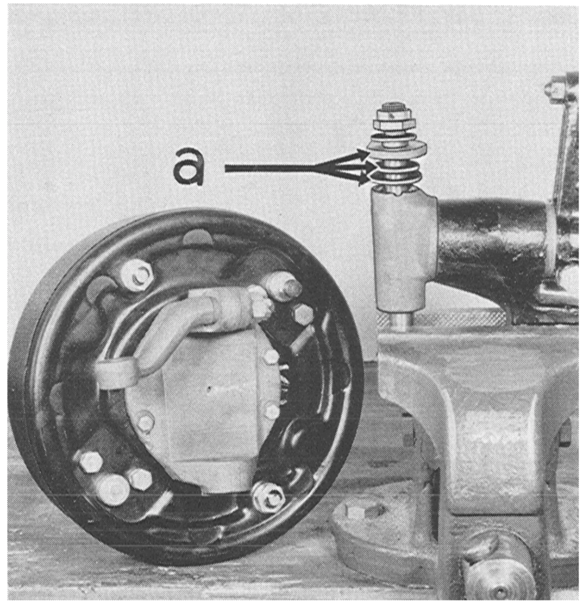

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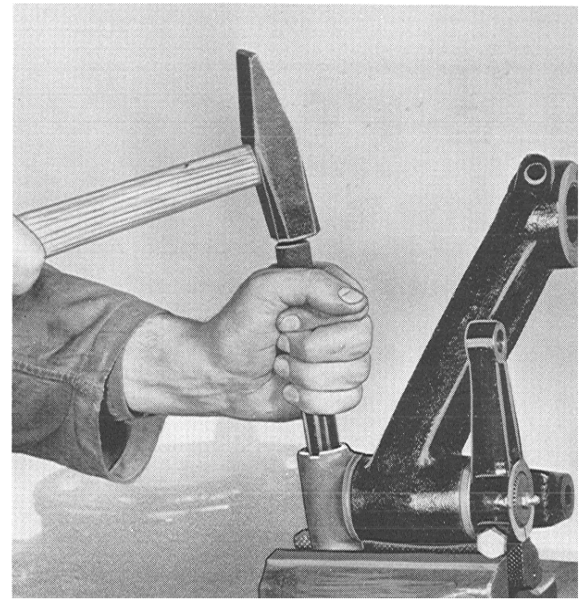

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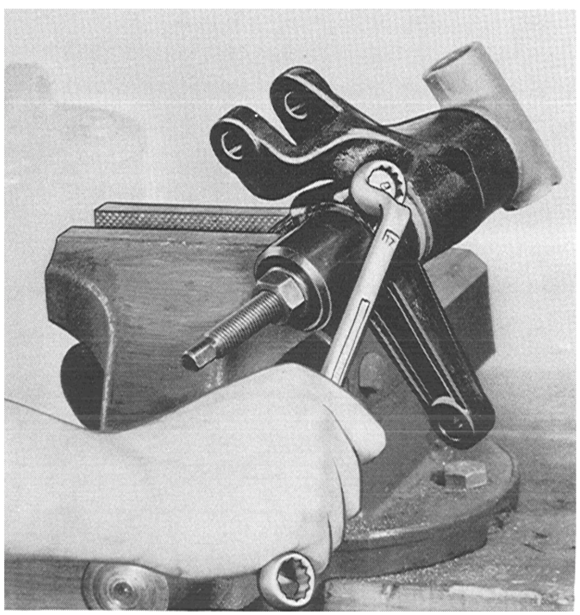

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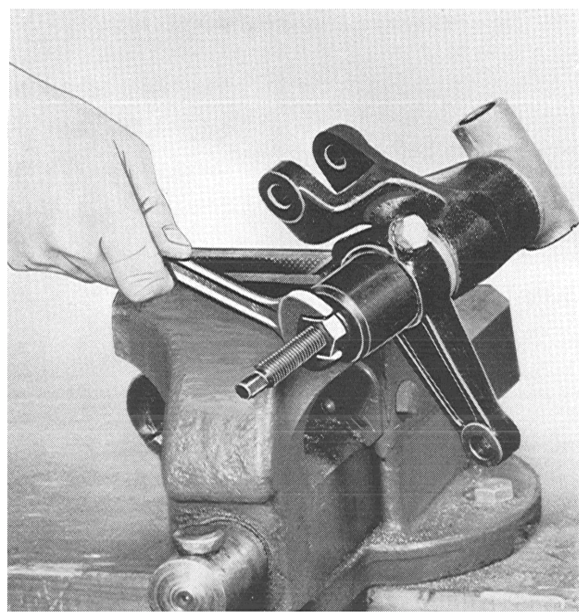

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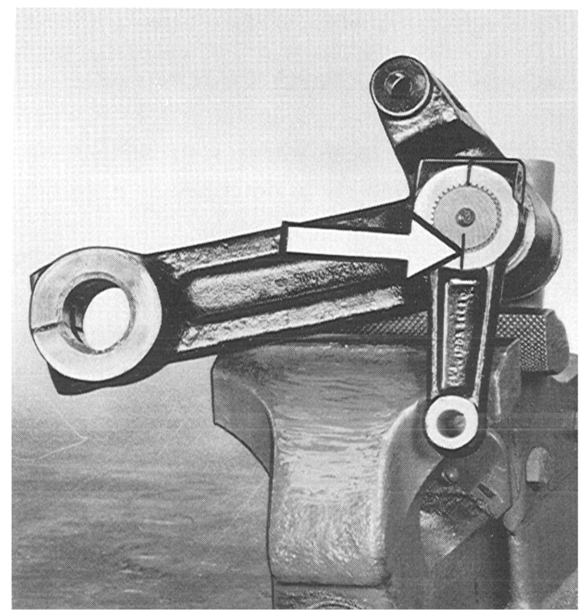

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REMOVING AND RENEWING THE STUB AXLE BUSHING AND OSCILLATING ARM BUSHING

To carry out this repair operation, it will be necessary to remove the following items.

1. Remove the split pins and hexagon castellated nuts from the track rods and steering tie rods, remove the track rod ball joint yoke with special tool AC 24. And remove the steering tie rod ball joint yoke with special tool AC 24 from the steering knuckle arm.
2. Unscrew and remove the oscillating arm clamping bolt.
3. Disconnect the brake hose top union, and plug the hole with a suitable wood or rubber stopper to avoid any unnecessary loss of brake fluid.
4. Unscrew and remove the resilient leg bottom fastening bolt and hexagon nut.
5. Remove the oscillating arm.

   Clamp the complete oscillating arm after thoroughly cleaning in a bench vice.
6. Remove the split pin and unscrew the castellated nut from the stub axle bolt, remove plain washer.
7. Use the special tool AC 3, figure 1, to remove the stub axle bolt, remove thrust bearing, thrust ring and bearing holding cap, withdraw the stub axle, figure 2 (a).
8. Remove the stub axle oscillating shaft bushings using special tool AC 4, see figure 3.
9. Unscrew and remove the steering knuckle arm clamping bolt with toothed washer. Should the clamping bolt be hard to turn, then remove the grease nipple from the shaft end, and insert the special tool AC 22 into the thread grease nipple hole, and fully tighten the hexagon nut, this will release the pressure from the clamping bolt, see figure 4 and 5, and enable the bolt to be turned easier.

ATTENTION

Before removing the steering knuckle arm from the splined shaft, it is most important to check that both the steering knuckle arm and splined shaft have a marking as shown in figure 6, this is to ensure a correct position when re-assembling.

Should no marking be found on the earlier models, then mark both parts before removing.

10. Remove the steering knuckle arm with distance shims and large plain washer, and withdraw the stub axle oscillating shaft out of the oscillating arm.

    Check the oscillating arm bushings and stub axle oscillating shaft, for wear or damage.


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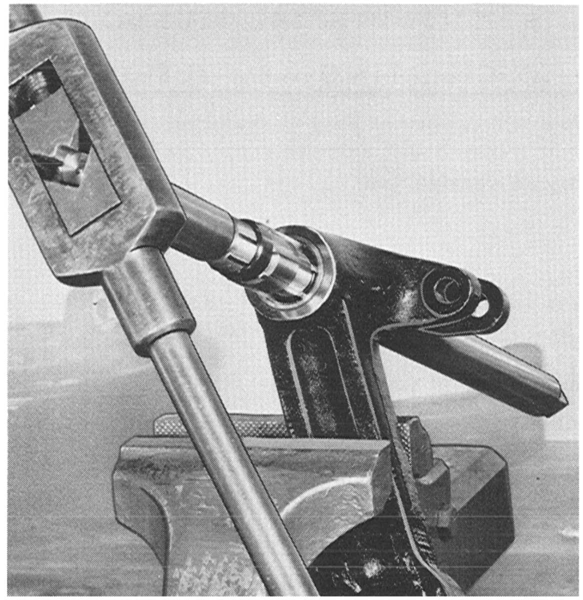
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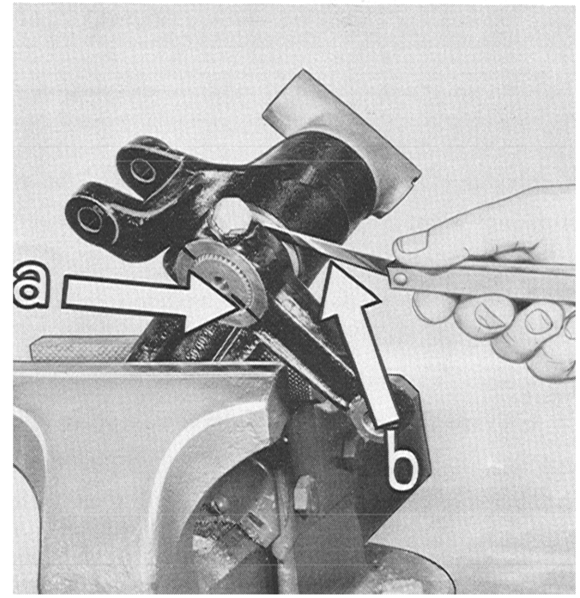

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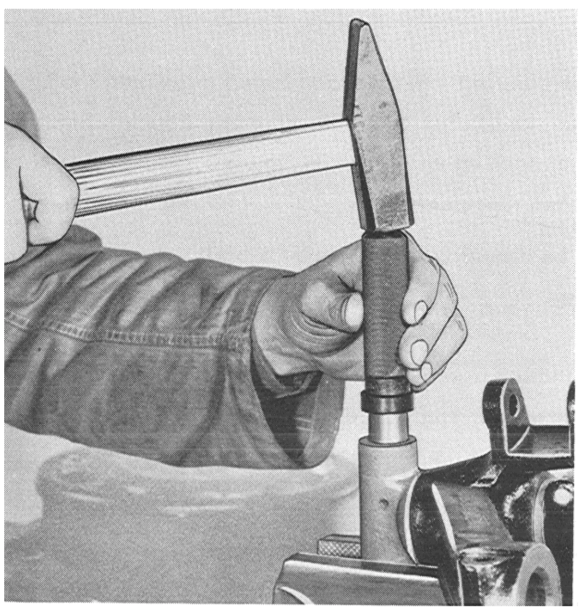
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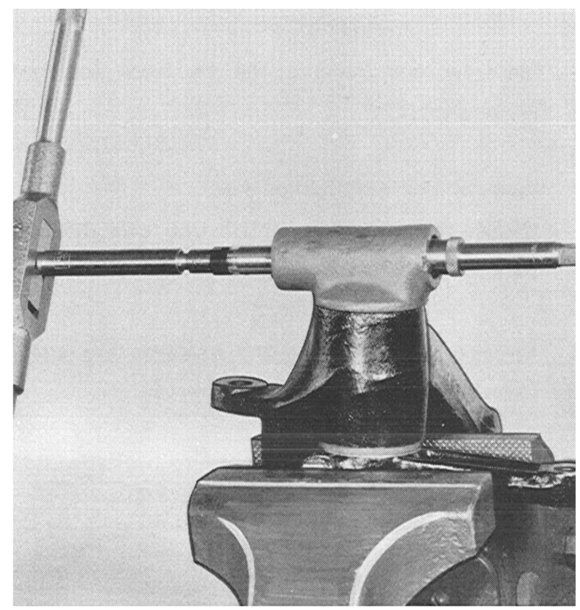
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RENEWING THE OSCILLATING ARM BUSHING AND STUB AXLE OSCILLATING SHAFT

1. To remove and refit the oscillating arm bushing use the special tool AC 6 as shown in figure 1.
2. After fitting a new bushing, this must be reamed out with the special reamer AC 19, figure 2, after which fit the stub axle oscillating shaft, to make sure the fitting is good.
3. After reaming the oscillating arm bushing, thoroughly clean all metal shavings away, and smear the stub axle oscillating shaft with oil before inserting it into the bushing, fit plain washer and distance shim rings. Fit the steering knuckle arm, so that both markings are matched together, see figure 3a.

   Should it be necessary to carry out this work while fitted in the vehicle use the special tool AC 22 threading the hexagon nut as tight as possible. This will enable lighter fitting of the clamping bolt, and also the side play can be checked, figure 3b, with a feeler gauge between the steering knuckle arm and oscillating arm, the play must be adjusted by either removing or adding distance shim rings, so that the clamping bolt can be easily inserted without damaging the thread.

NOTE: If no special tool is available, when the unit is removed from the vehicle, the steering knuckle arm can be pressed under a pressing machine.

4. Finally tighten the clamping bolt, fit the grease nipple, and grease with an hydraulic greasing unit using only Multi-purpose grease, until it squeezes out around the shaft, forming a collar which prevents water from entering the bushing.

RENEWING THE STUB AXLE OSCILLATING SHAFT BUSHING, AND STUB AXLE BOLT

1. To refit new bushings use the special tool AC 5, see figure 4.

   ATTENTION

   The bottom bushing (recess end of the stub axle oscillating shaft), must be driven farther into the bore using the special tool AC 4, figure 5, until the bushing is flush with the bottom of the recess, this will enable a correct fitting of the thrust bearing holding cap.

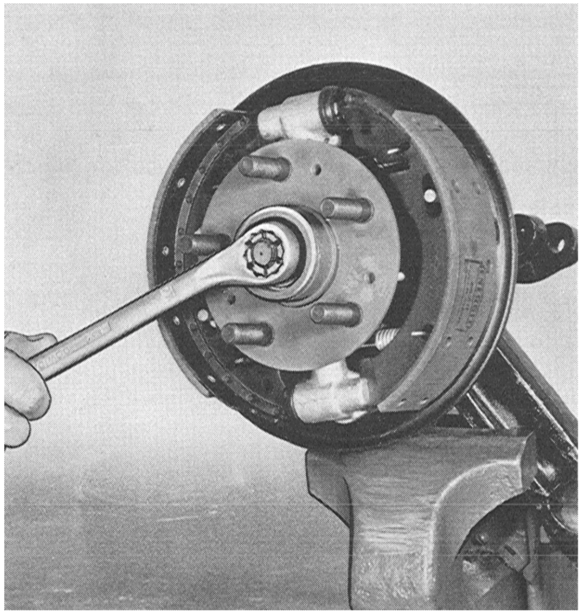
2. After refitting the bushings, these must be reamed with the special reamer AC 7, figure 6, before fitting a new stub axle bolt.
3. Refit stub axle oscillating shaft into the stub axle with thrust ring, holding cap and thrust bearing, then fit stub axle bolt slightly smeared with oil, fit plain washer, and tighten the castellated nut. Loosen the castellated nut one-sixth turn (60 degrees) and lock it with a split pin.

   ATTENTION

   To obtain the correct adjustment between stub axle and stub axle oscillating shaft, thrust bearings are obtainable from our Service Parts Department in the following sizes:

   0,217" (5,5 mm) 0,218" (5,7 mm) 0,219" (5,9 mm)

   0,220" (6,1 mm) 0,221" (6,3 mm) and 0,222" (6,5 mm)



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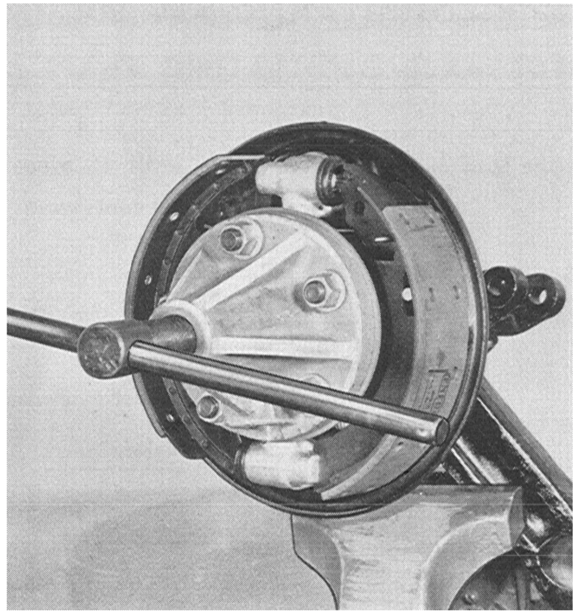

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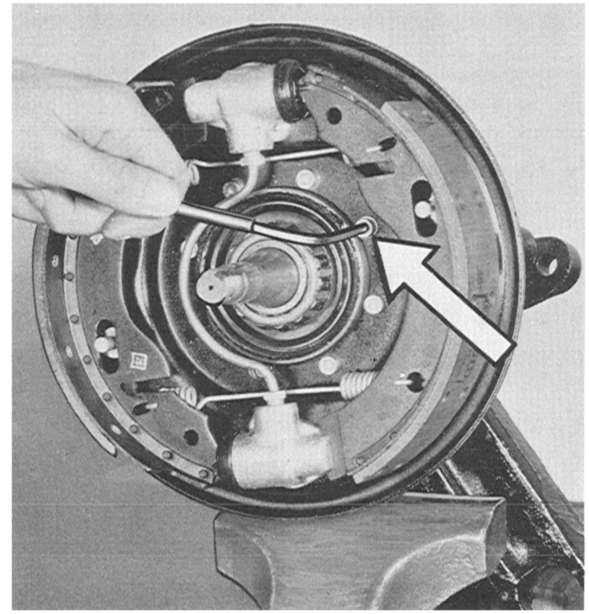

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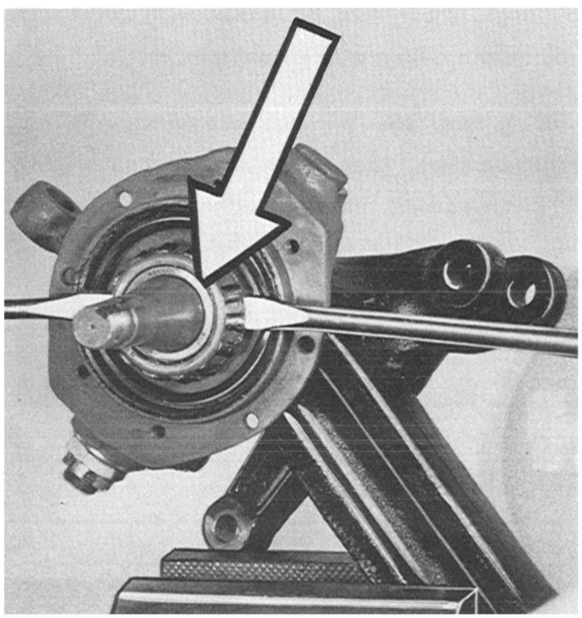

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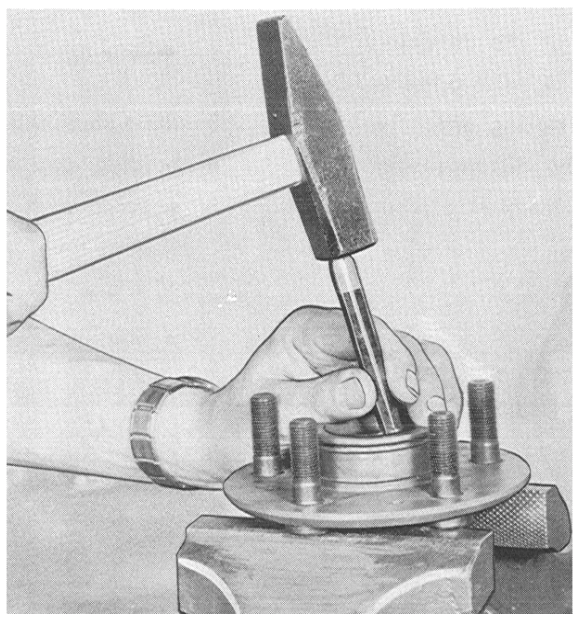

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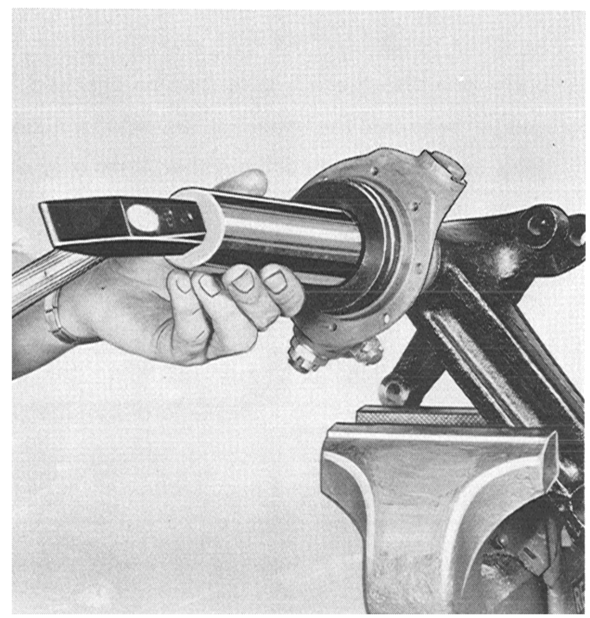

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REMOVING AND RENEWING THE WHEEL HUB TAPER ROLLER BEARINGS AND OIL SEAL

Dismantling is in the following order.

1. Remove the wheel hub rubber protection cap.
2. Unscrew the brake drum three countersunk fastening screws and remove the brake drum.
3. Clean grease from the stub axle end, remove split pin and unscrew the castellated nut, figure 1, remove plain washer.
4. Use the special tool AC 14 to remove the wheel hub as shown in figure 2, together with the small taper roller bearing.
5. Unscrew the brake anchor plate fastening screws with spring washers, using a 4 mm allen key, figure 3.

   Thoroughly clean and check the taper roller bearing and oil seal for wear or damage, if damaged, remove the taper roller bearing from the stub axle, figure 4. Remove radial oil seal.

   ATTENTION

   Should it be necessary to renew the taper roller bearings, then the bearing outside ring must be removed as shown in figure 5, from the wheel hub bore.

   Taper roller bearing cage and outside ring must always be renewed as a pair.

ASSEMBLING

1. Press new taper roller bearings outside ring into the wheel hub, using AC 9 and AC 30, and smear with grease.
2. Fit a new radial oil seal into the stub axle with the special tool AC 2 together with AC 35 as shown in figure 6.
3. Fit a new large taper roller bearing cage onto the stub axle by using the special tool AC 1.
4. Refit the brake anchor plate into its correct position and tighten the fastening screws.
5. Fit the wheel hub onto the stub axle, taking care not to damage the radial oil seal lip while pushing it in. Pack the wheel hub with Multi-purpose grease, and push the small taper roller bearing cage onto the stub axle.
6. Fit the washer and castellated nut, tightening the nut to approximately 21,6 ft. lb. torque, and then loosen the nut one sixth turn (60 degrees) and lock the nut in this position with a split pin. Recheck to see that the wheel hub turns freely but without play.

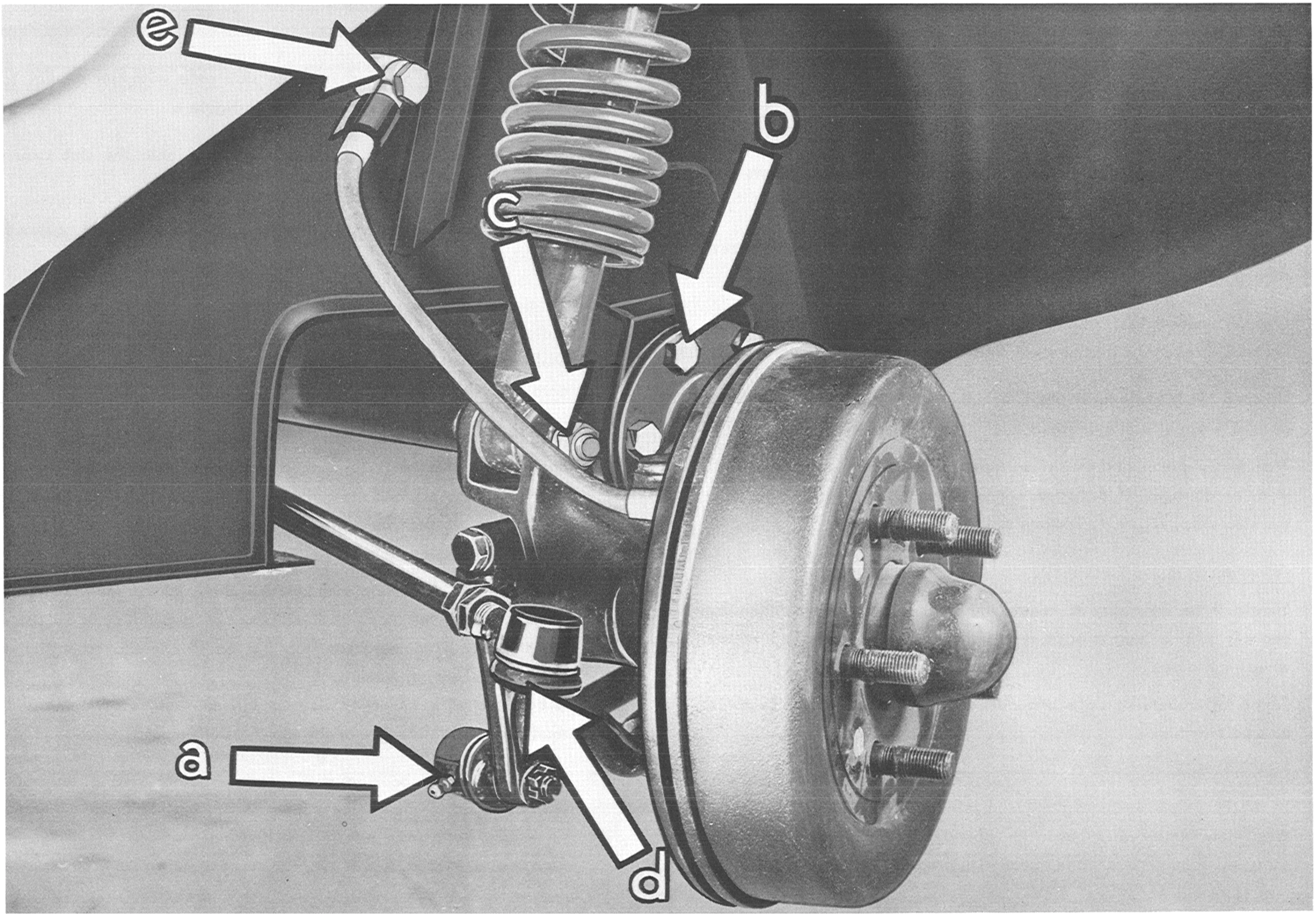
   ATTENTION

   This adjusting operation must be carried out with great care, for the life time of the taper roller bearings depend upon a correct adjustment. If adjusted too tight, it could cause overheating and destroy the bearing seating.

   If adjusted with too much play, it will cause excess swaying on the road and shorten the life of the taper roller bearing.

7. Smear the small bearing with grease, before fitting the rubber protection cap. The rubber cap must fit tight onto the wheel hub, to prevent water from entering the bearings.

   Porous or damaged rubber protection caps must always be replaced.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ASSEMBLING AND REFITTING THE COMPLETE FRONT AXLE

1. Fit the rear steering tie rod yoke into the steering knuckle, tighten the castellated nut and lock with a split pin, figure 1a.

NOTE: The overhauling, assembling and refitting of the axle housing with axle is described in the Group 4, Rear Axle, page 4/7.

2. After reassembling the complete front axle, it can then be fitted into the vehicle.
3. Check the axle housing gasket, replace if necessary, fit axle housing and tighten the fastening bolts, figure lb.
4. After inserting the resilient leg fastening bolt, raise the oscillating arm with a hydraulic jack to enable the silent block to obtain its normal loaded position. While still raised, tighten the hexagon bolt, figure 1c.

   This operation will prevent any unnecessary wear to the silent block as the oscillating arm swings.
5. Fit the front steering tie rod yoke, tighten the castellated nut and lock with a split pin. Also refit the track rod yoke, figure 1d, then fit the front yoke.
6. Remove the plug from the brake hose connection and reconnect the brake hose, figure 1e, but making sure that the copper gasket ring is in good condition.

   ATTENTION

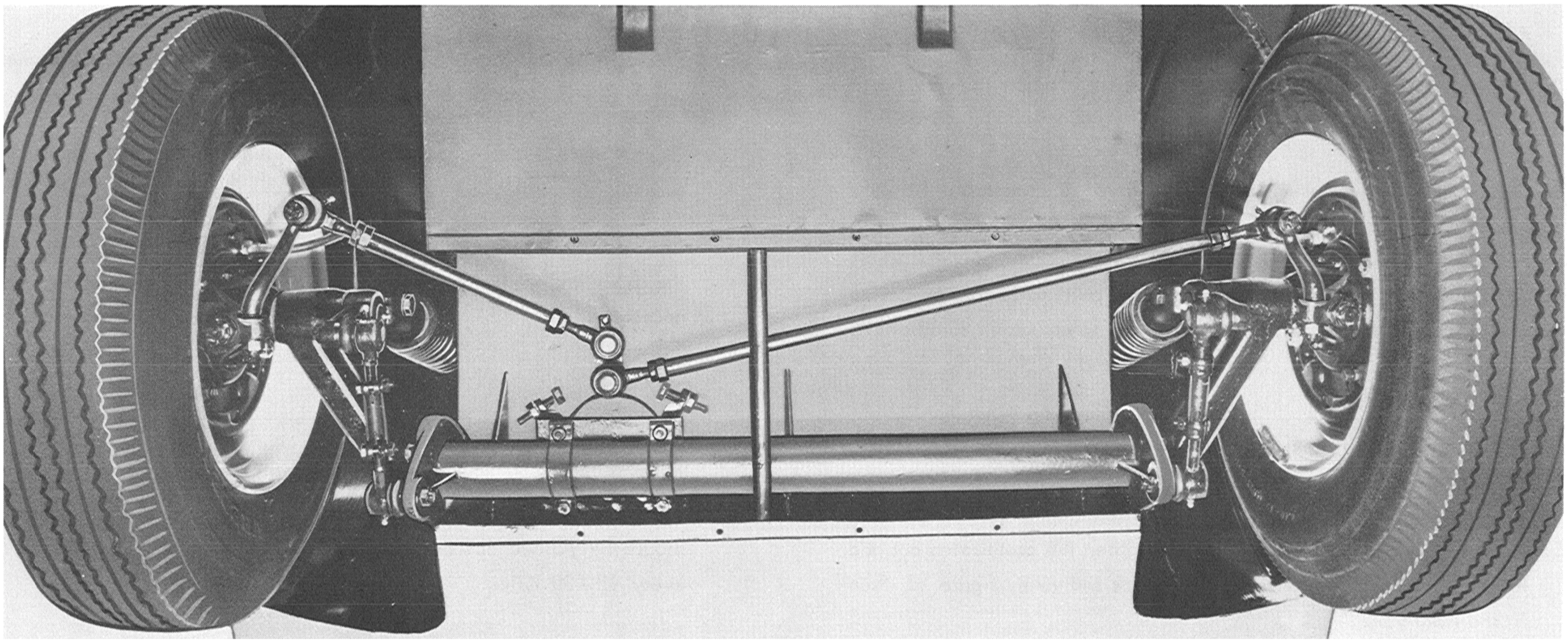
   After fitting the brake hose it is most important to bleed the brake system as described in Group 6, Brakes, page 6/15.

   Grease all lubricating points of the front axle with Multi-purpose grease.

   Al so it is most important after repair work has been carried out on the front axle, to check the wheel alignment, and readjust if necessary.

MAINTENANCE

Apart from the specified greasing of the front axle, the wheel hubs should be washed out and repacked with new Multi-purpose grease every 12,000 miles.



WHEEL ALIGNMENT AND ADJUSTMENT

GENERAL

Safe driving depends upon proper wheel alignment and wheel adjustment, that is, upon the position of the wheels to each other and their position to the road.

Incorrect wheel adjustment can result in one-sided tire wear, or incorrect track holding, which results in a "steering wobble" being carried over the steering linkage and being felt at the steering wheel.

The driver is not always aware of the fact, that some times a sl ight bump of the wheels into the curb or any other minor accident of a similar kind may cause an alteration in the track or wheel adjustment, and that afterwards this may result in excessive tire wear.

To find these faults it is recommended to check with a optical measuring device, although these checks can be performed with a track camber and castor tester, of simple design.

The following points must be taken into consideration to obtain a correct wheel alignment.

1. TIRES

A good tire thread with an even wear is necessary. If required new tires should be fitted for the aligning check.

2. TIRE PRESSURES

Correct tire pressures of all four wheels must be maintained.

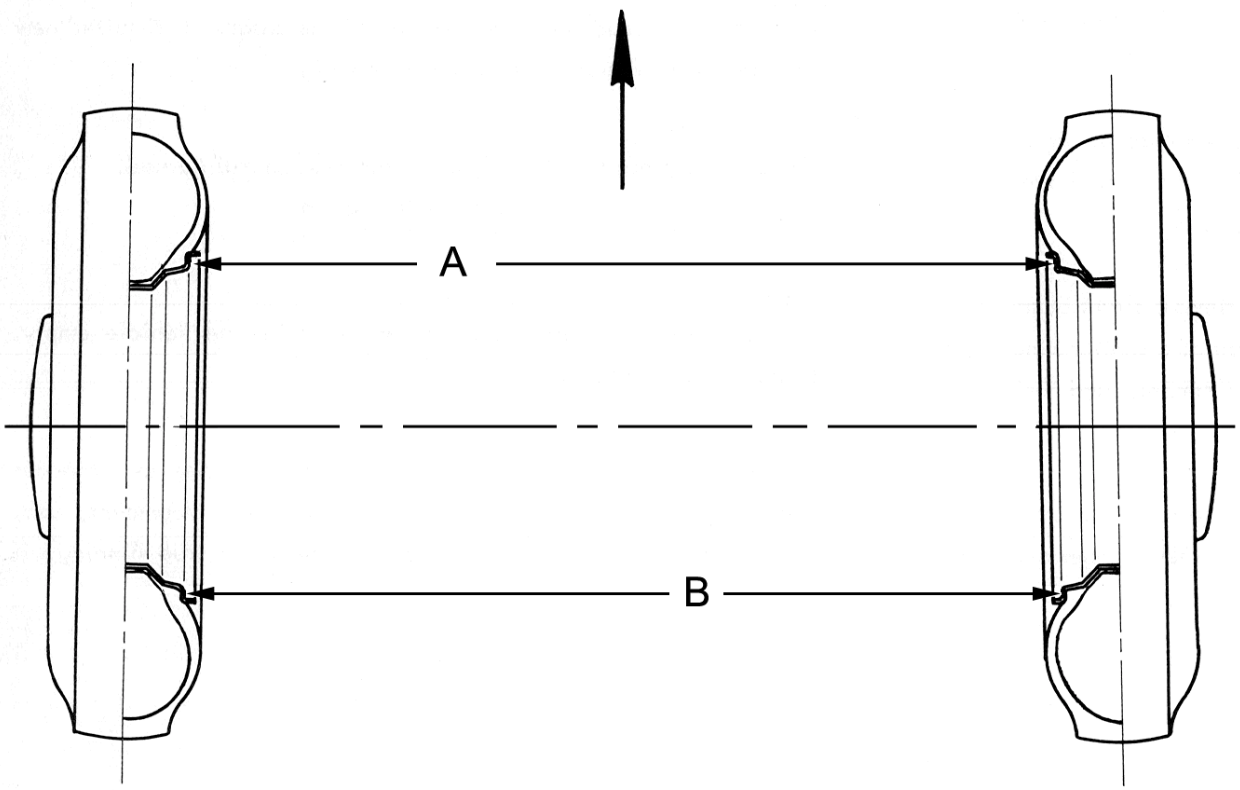
Front	14 lbs/sq. in.
Rear	30 lbs/sq. in.

3. LOADING

The alignment test must be carried out with the vehicle empty. Loading is not necessary.

4. WHEEL RIMS

Damaged or untrue running wheel rims can give rise to erroneous measuring results. Therefore before measuring the alignment, jack the vehicle up and turn the wheels to check for true running, if necessary replace them.



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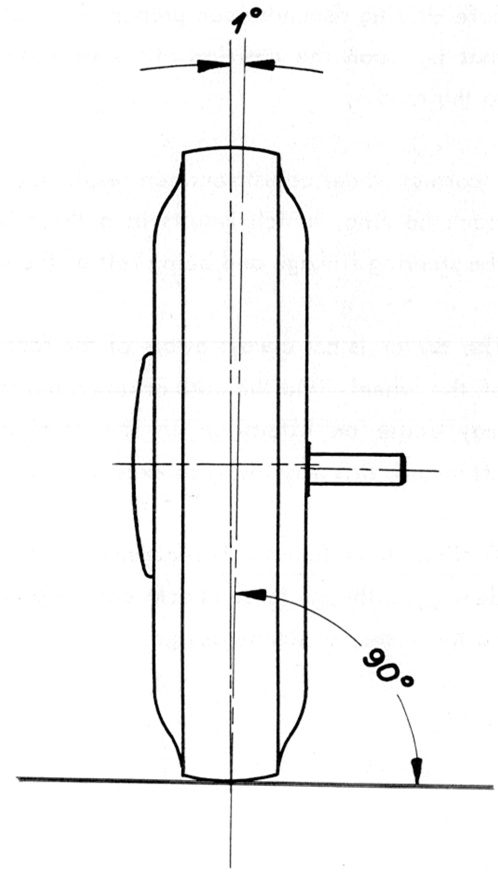

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5. SPRING AND SHOCK ABSORBERS

All springs with shock absorbers must be in perfect order. A defected resilient leg must be renewed as a pair.

6. WHEEL BEARINGS

If possible the wheel bearings should be without play, should a great wear be found for example on the following parts, stub axle bolt, oscillating shaft, steering knuckle arm or steering tie rod ball joint yokes, steering arm or the lower control arm, then defected parts must be renewed before carrying out the alignment test.

It is recommended after fitting new parts, to make a short trial run, this will enable the replaced parts to obtain their correct seating.

DEFINITIONS AND ADJUSTMENT

1. TOE-IN, FIGURE 1.

Toe-in denotes the difference in the distance between the rims of a pair of wheels when they are out of parallel ism. If the distance between the wheels is smaller at the front "A ", than at the rear "B", the toe-in is positive, on the contrary it is negative. The toe-in must be measured at wheel centre height/ with the wheels in the straight-ahead position. The toe-in must be positive 1/32" to 1/8" (= 10' to 30' minutes).

The adjustment of the toe-in must be corrected on the longer track rod, the basic measurements are as follows.

Right track rod	29,133"	+/-	0,394"
Left track rod	16,385"	+/-	0,394"

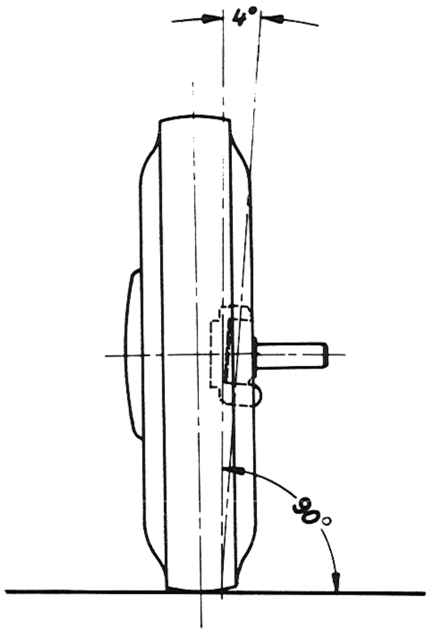
These track rod measurements are only after Chassis number 101 501 for green and red cars, and after Chassis number 100 801 for white and blue cars.

Each track rod is equipped with a right hand thread at one end and a left hand thread at the other end. For adjusting the length open the locking plates and loosen the outer hexagon nuts then by turning the middle piece either clockwise or anti-clockwise the length can be adjusted/ but if possible keeping within the limits of the basic measurement as stated.

2. CAMBER, FIGURE 2.

The tilt of the wheel from the vertical erected at right angle to the road plane is called camber. If the wheel is tilted outwards, the camber is positive, and negative if tilted inwards.

The desired camber angle of the Amphicar is 1 degree +/- 45' minutes positive.



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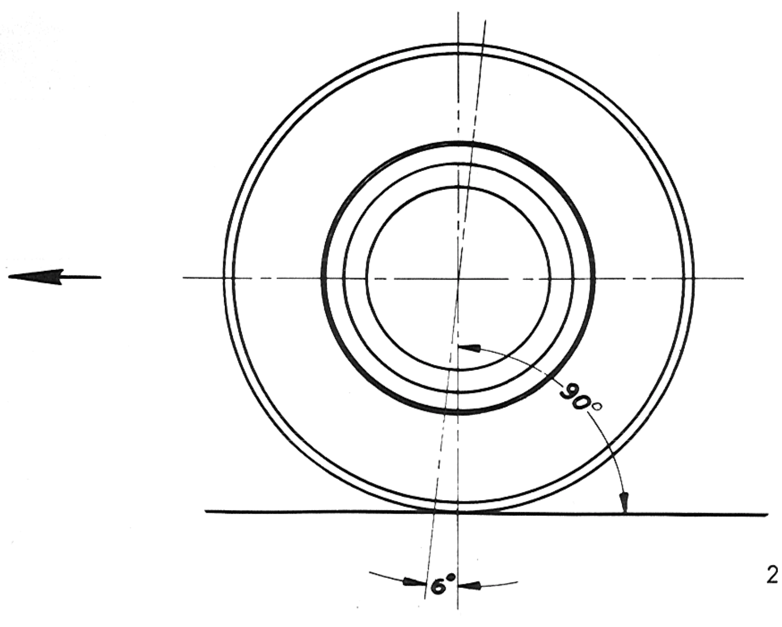

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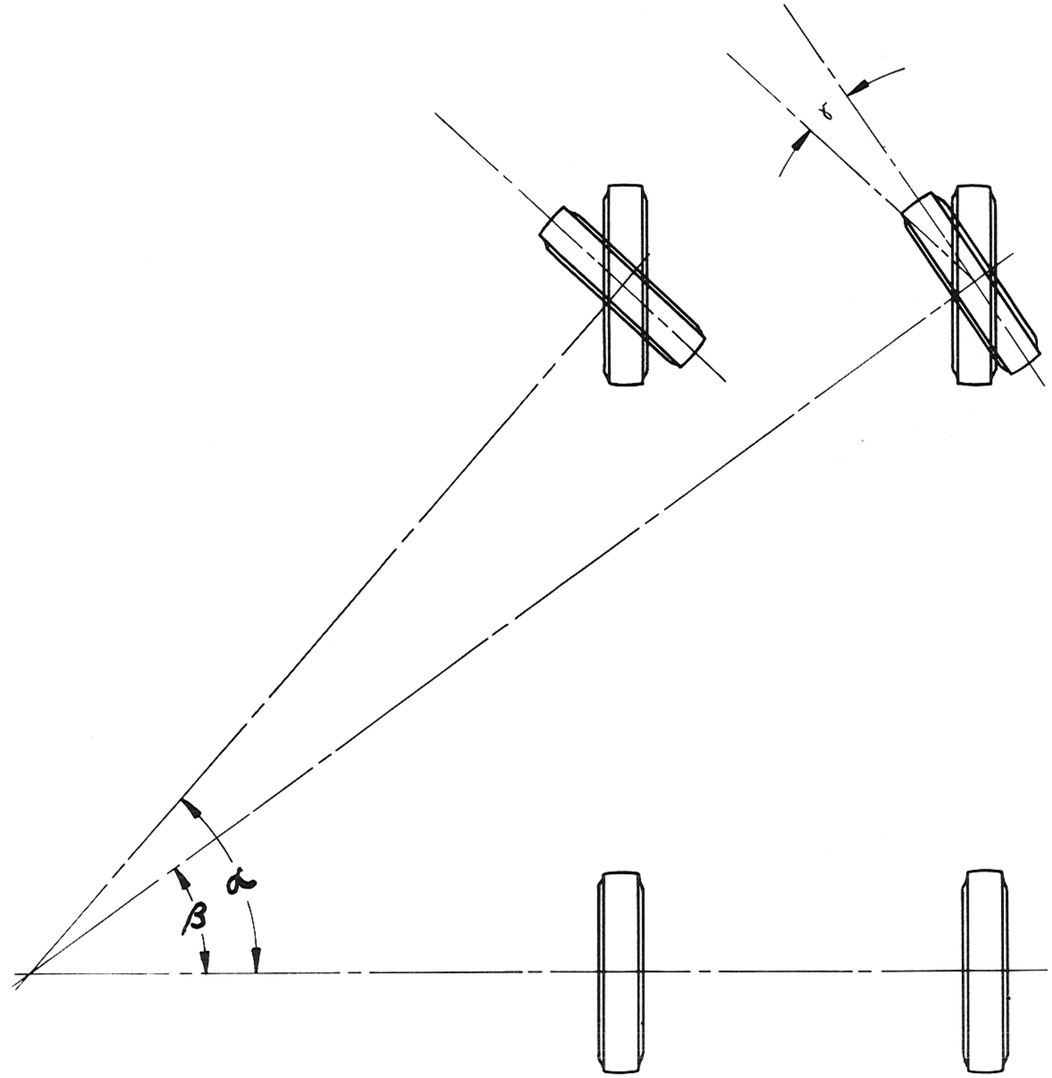

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3. STUB AXLE BOLT INCLINATION, FIGURE 1.

The tilt of the stub axle bolt with respect to a vertical erected at right angle to the road plane is termed inclination.

The designed stub axle bolt inclination of the front axle is 4 degrees.

4. CASTER, FIGURE 2.

Caster is the distance between the point where the stub axle bolt centre line intersects the road plane, and the vertical through the wheel centre. If the vertical through the wheel centre viewed in the direction of motion, lies behind the point of intersection of the stub axle bolt centre line, then the caster is positive, inversely it is negative.

The caster should be 6 degrees, +/- 30' minutes. The adjustment of the caster angle is to be adjusted on the steering tie rods.

5. TOE-OUT DIFFERENCE ANGLE, FIGURE 3.

When the car is moving straight ahead the front wheels are traveling parallel or approximately parallel to each other.

Due to the radius during turning the outer wheel follows a curve much larger than that of the inner wheel.

In order to obtain good steering performance of the vehicle, both front wheels should be at right angles with respect to the focal point of the curve, so that both wheels will give an accurate turning circle around the focal point of the curve.

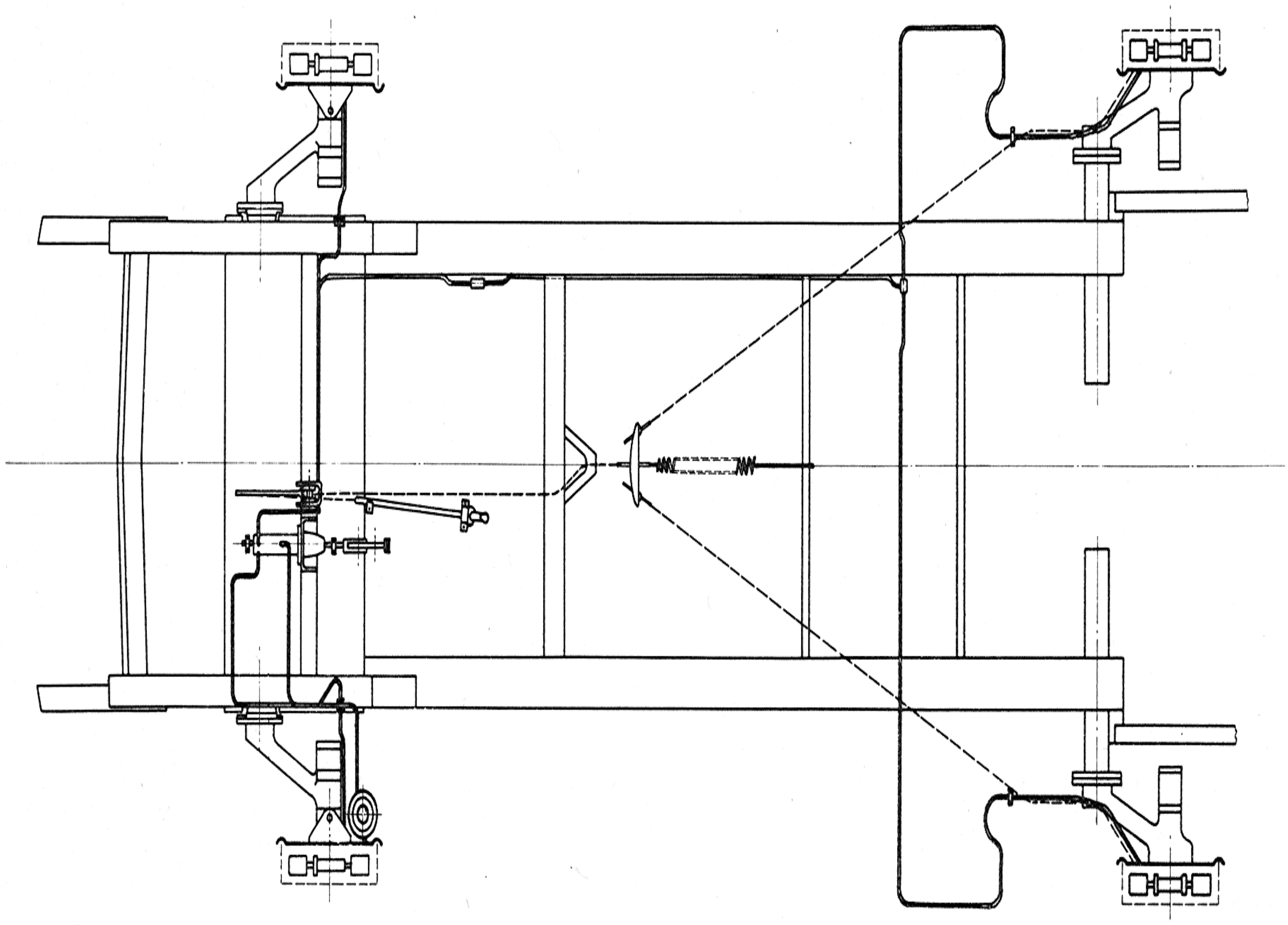
It results there from, that the wheels when making a turn, are no longer parallel with each other thanks to the design of the steering geometry.

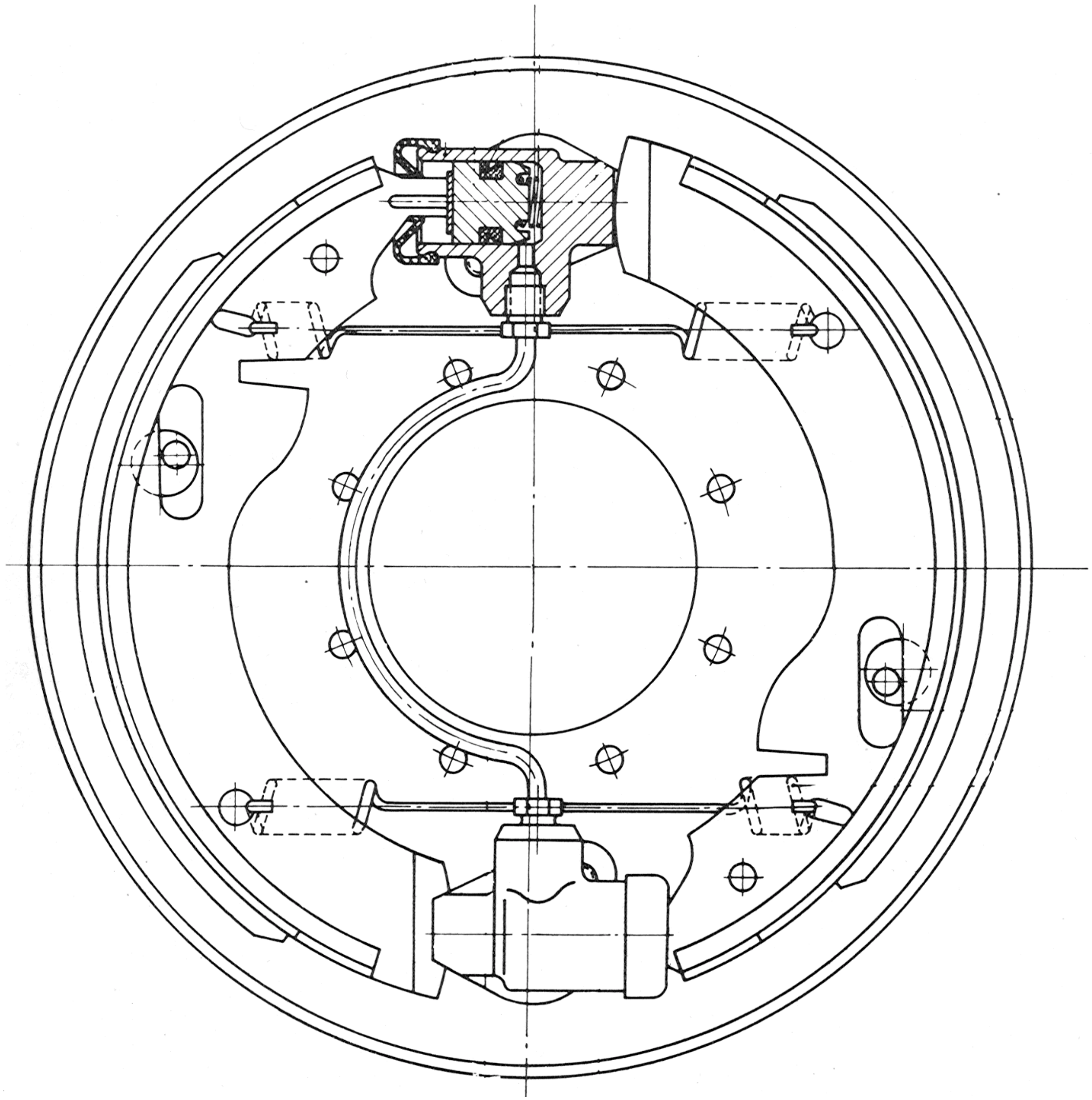
The difference in the angles (a - b) between the inner and outer wheel is termed "toe-out difference angle". At an angle of 20 degrees the inner wheel "toe-out difference angle" is 3 degrees +/- 30' minutes.

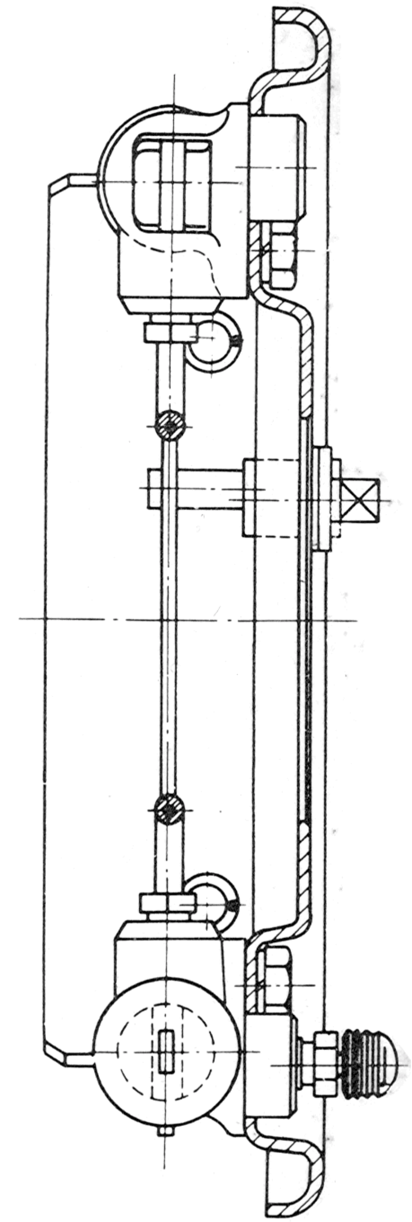
This nominal value has been found by calculation and checked on several trial runs, it must therefore be maintained with due regard to the permissible tolerances, and should, if possible, be the same particularly with the wheels turned to the right and to the left.

a 1 = Parallel to "a"

b = Position of the outer wheels on turns.







BRAKE SYSTEM

DESCRIPTION

The braking system consists of hydraulically operated brakes that apply the brake shoes simultaneously to all four wheels, and a mechanically operated parking brake that applies the brake shoes to the rear wheels only.

The hydraulic braking system consists of a master cylinder, which is connected to six wheel brake cylinders, two of these being fitted to each front wheel unit, and one to each rear wheel unit.

The master cylinder itself consists of a single die cast cylinder. The piston which operates in the cylinder bore is fitted with rubber cups and the recuperating valve mechanism, and is finally connected by an adjustable piston-rod to the brake pedal.

When the brake pedal is depressed, the piston in the master cylinder forces the brake fluid at an equal pressure to each of the six cylinders, which in turn pushes the brake shoes against the brake drum, and thus provides a retarding force to wheel rotation.

PARKING BRAKE

The parking brake is mechanically connected by cables and linkage and operates the rear wheels only, independently of the hydraulic system. The parking brake is applied and released by a pull handle which is mounted under the instrument panel.

STOPLIGHT SWITCH

The stoplight switch is screwed into the end of the master cylinder, and is connected with a cable to the rear stop lights.

SERVICE HINTS FOR MAINTENANCE AND REPAIR WORK

All maintenance or repairs on the Brake System should be carried out with extreme care.

1. Always before commencing any work on the wheel cylinders, master cylinder, brake lines and brake hoses, it is most important that they should be thoroughly cleaned, especially their bolted connections in order to avoid dirt from entering the system. Clean hands are also important so as to avoid oil or grease from entering the system. Dirt will impair the reliability and effectiveness of the brakes.

2. Brake fluids contain ingredients which act as dissolving agents on paint and varnish coats, therefore particular care must be taken while bleeding the system or carrying out repairs, that no brake fluid comes into contact with the paint-work.

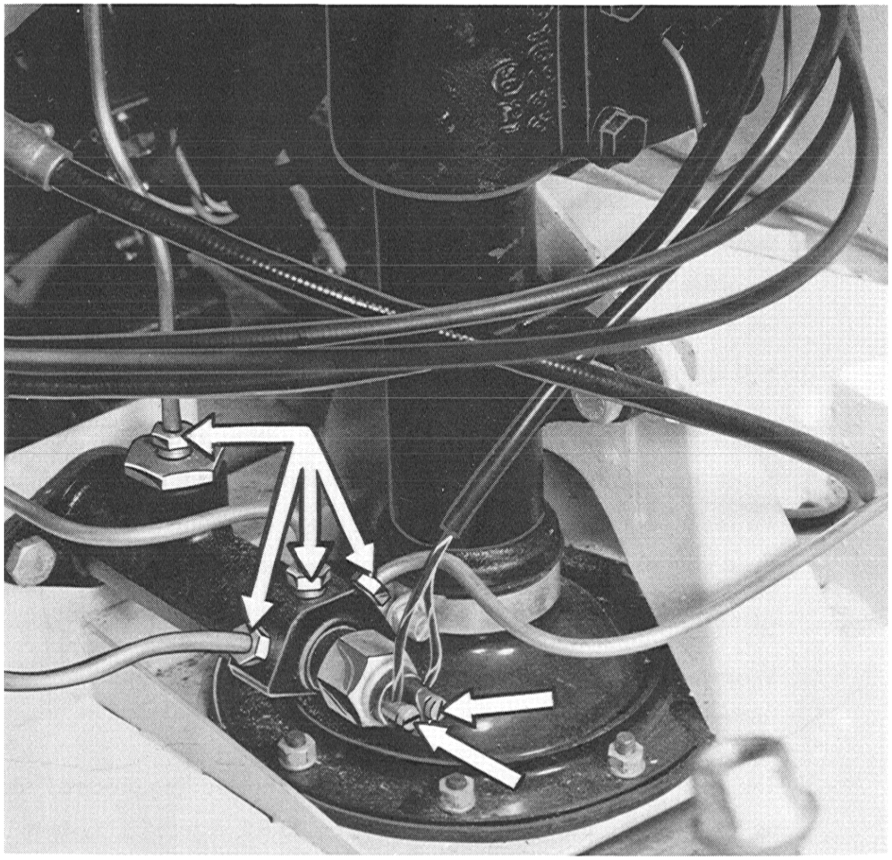
   ATTENTION

   If any brake fluid should be splashed into the eyes, wash out immediately with water.

3. The brake fluid which is pumped out in the bleeding process, should never be re-used, for foreign matter could enter the system, and therefore cause damage.

   ATTENTION

   Position of the pistons in the wheel cylinders. The rubber cup of the top wheel cylinder must be put each side in driving, direction of the car. Not opposite. Figure 1 shows the front brake unit, L/H side.



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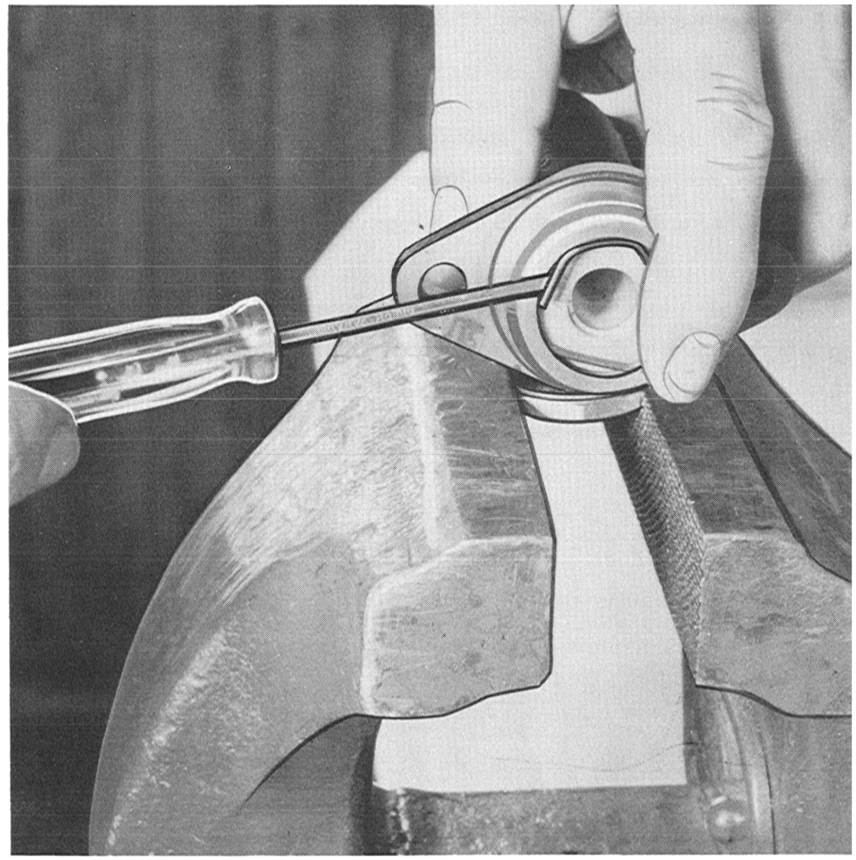

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4. If by mistake or ignorance a brake fluid other than prescribed has been used for refilling, it is necessary to drain the entire system, dismantle and thoroughly clean. Rubber parts of the hydraulic braking system are not mineral oil resisting, and require to be replaced if mineral oil or any other harmful fluid has been used.

   For cleaning, use only spirits or specified brake fluids. After cleaning has been carried out let the parts dry.

   In order to ensure a correct conservation of brake cylinder guides and pistons, they should be given a thin coat of brake cylinder paste before assembling.

   After refilling with brake fluid the system must of course be bled.

5. The braking system should be checked at regular intervals. Damaged brake hoses and brake lines should always be replaced. Furthermore, the cause or damage of the system must a always be eliminated.

6. Most important, at regular intervals, check the function of all wheel cylinders, the pistons must have a free movement. Always replace any damaged wheel cylinder rubber cup, for a porous or defective cup could let water enter into the wheel cylinder. This would result in rusting and blocking the wheel cylinder piston.

MASTER CYLINDER REMOVAL AND OVERHAULING

REMOVAL

1. Be sure that the area around the master cylinder and line connections are thoroughly clean, then disconnect the four hydraulic line connections, and stoplight switch cables, figure 1.

   ATTENTION

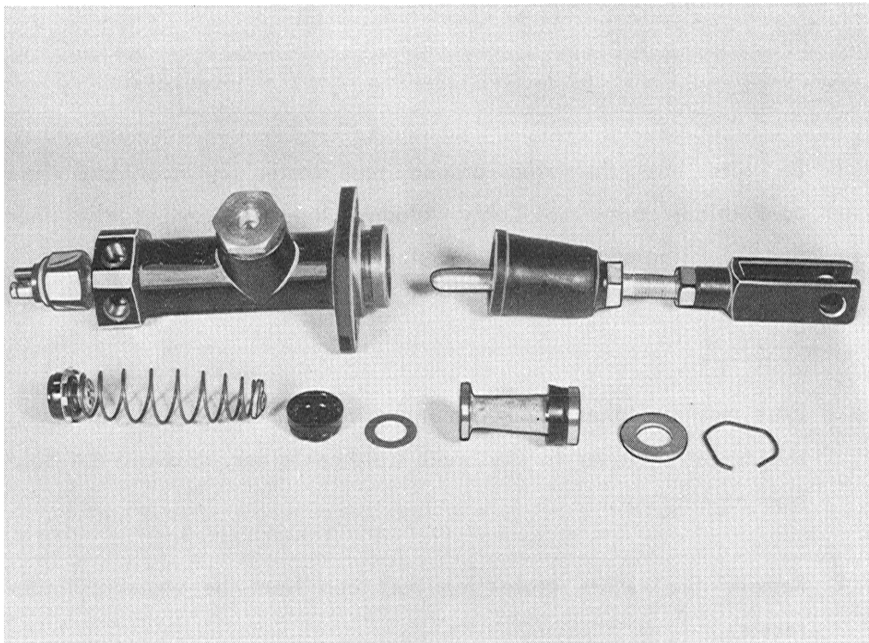
   Care must be taken when disconnecting the brake line connecting the master cylinder to the brake fluid container, to avoid the fluid from running out.

2. Remove the rubber protection dust cup from the master cylinder recess.

3. Unscrew and remove both master cylinder hexagon fastening bolts. Remove the master cylinder from the vehicle, taking care that the brake fluid which is still left in the cylinder and the brake lines does not run out, and come into contact with the paintwork.

OVERHAULING

1. Remove the piston retaining safety ring, thrust washer, figure 2.



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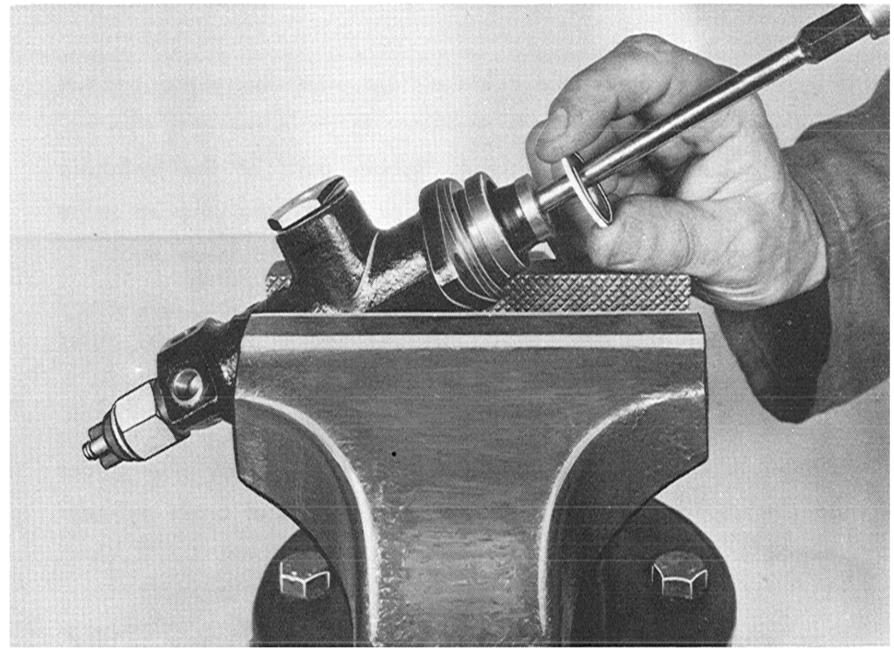

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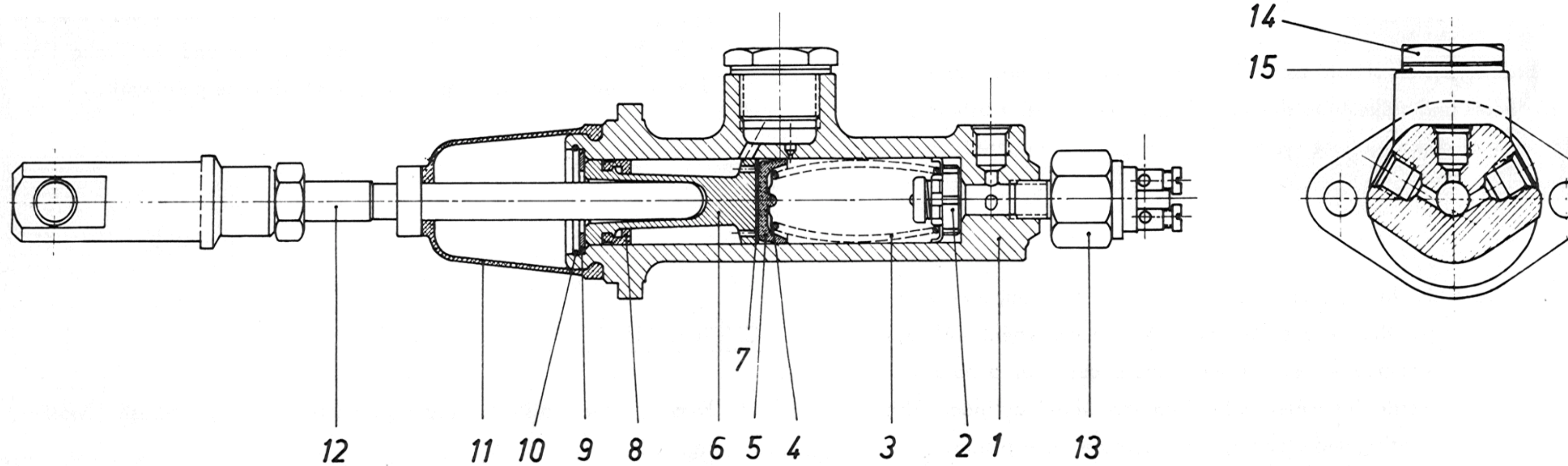

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piston with rubber cup, filling disc, spring cap, spring and valve. Should the piston fail to come out freely, use a screwdriver, applying it at the seat of the push rod.

2. Clean all parts thoroughly in spirits or original brake fluid. Don't use Gasoline or other solutions for this can result in the destruction of the rubber parts.

   Check master cylinder and components. Replace damaged or worn parts. It is always good practice to replace the primary cup and the rubber cap.

   ATTENTION

   Should the master cylinder bore be scored or badly damaged, then a new master cylinder must be fitted.

REASSEMBLING

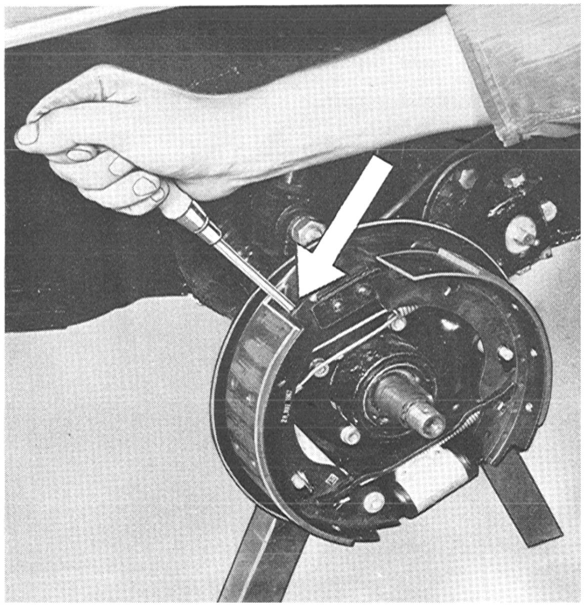
1. Lightly smear the master cylinder bore and piston with brake cylinder paste.
2. Insert the compression spring with bottom valve, primary cup, filling disc, piston and rubber cap, figure 1.
3. Carefully push with a blunt instrument the piston inwards, figure 2, insert stop washer, and put safety spring into position using pointed pliers.

   Refitting the master cylinder is in the reverse order as by the removal, but lubricate the push rod with a light film of brake fluid to facilitate positioning of the rubber dust cap to the master cylinder cavity. The small hole in the rubber dust cap must be positioned so that it is perpendicular to the bottom.

4. After fitting, the play must be checked between push rod and piston, and should be 0,02" to 0,039". The play can be adjusted on the push rod.

MASTER CYLINDER, FIGURE 3

1. Housing
2. Bottom valve
3. Return spring
4. Return spring seating
5. Filling disc
6. Piston with rubber cup
7. Washer
8. Secondary cup
9. Piston stop
10. Snap ring
11. Protecting cap
12. Plunger rod
13. Stop light switch
14. Threaded connection piece
15. Gasket ring



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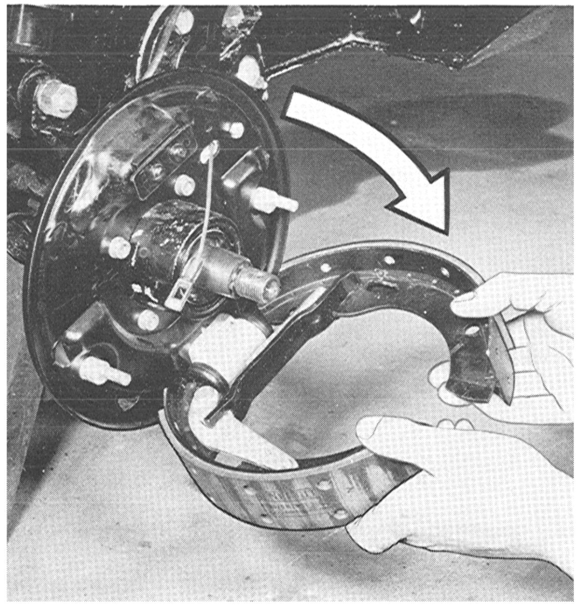

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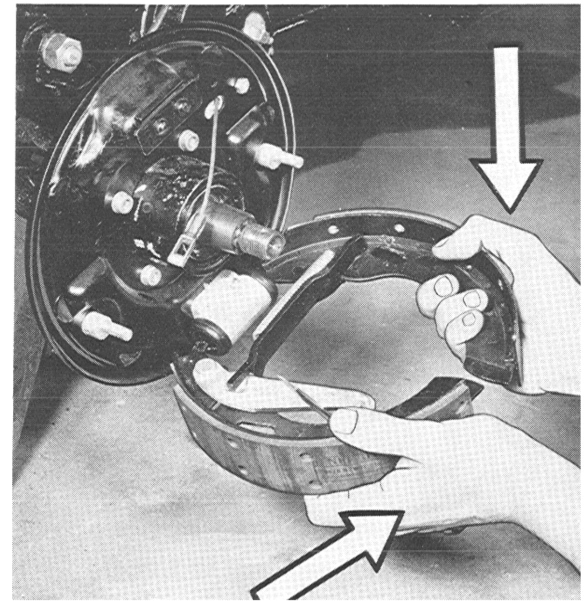

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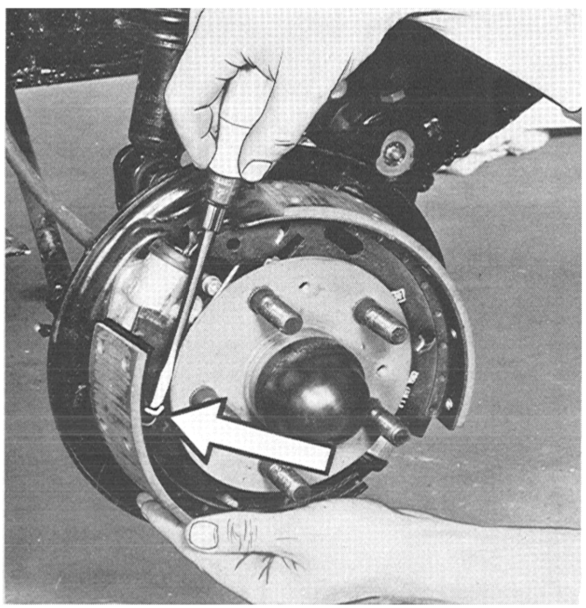

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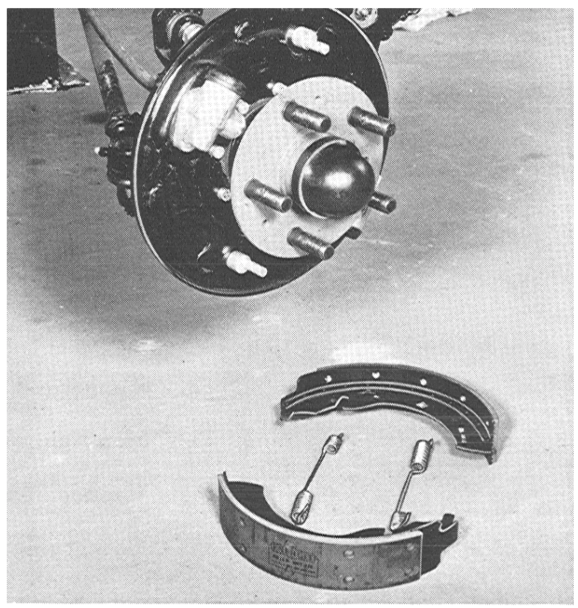

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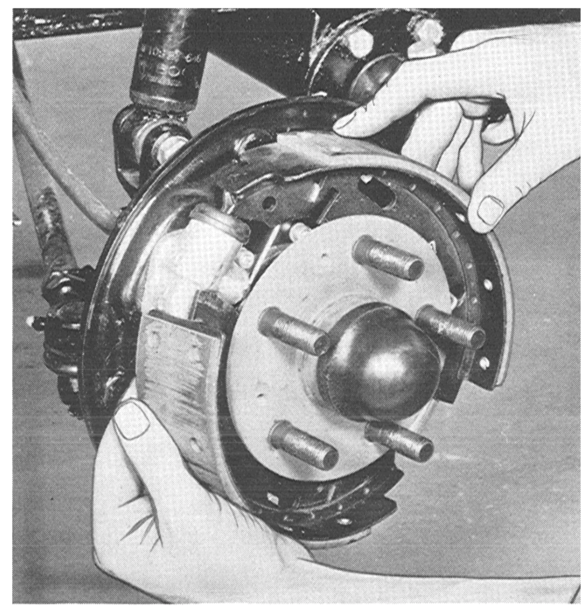

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REMOVING AND INSTALLING THE REAR WHEEL BRAKE SHOES

1. Remove the rear wheel caps, and slacken the wheel nuts before raising the vehicle as described on page 1/8, figure 1 and 2. Remove the wheels.
2. Unscrew three countersunk fastening screws and remove the brake drum. It is necessary to remove the rubber protection cap, split pin from the castellated nut and unscrew nut, then by using the special tool AC 14 remove the rear wheel hub. This will make the removal of the brake shoes easier.
3. Lever the brake shoes with a screwdriver out of the upper holding plate, as shown in figure 1, disconnect the top tension spring, and lever the brake shoe to the centre and disconnect the hand brake cable.
4. Then by holding both brake shoes, draw them forward and lower as shown in figure 2, press both shoes together at the top, figure 3, and remove the brake shoes from the wheel cylinder, but taking great care not to damage the rubber protection boots. Finally remove the remaining bottom tension spring and lever strut.

   Fitting is in the reverse order, but checking that the adjusting eccentric is turning freely.

REMOVING AND INSTALLING THE FRONT WHEEL BRAKE SHOES

1. Unscrew the three countersunk fastening screws and remove brake drum.

NOTE: To remove the front brake shoes it's not necessary to remove the front wheel hubs.

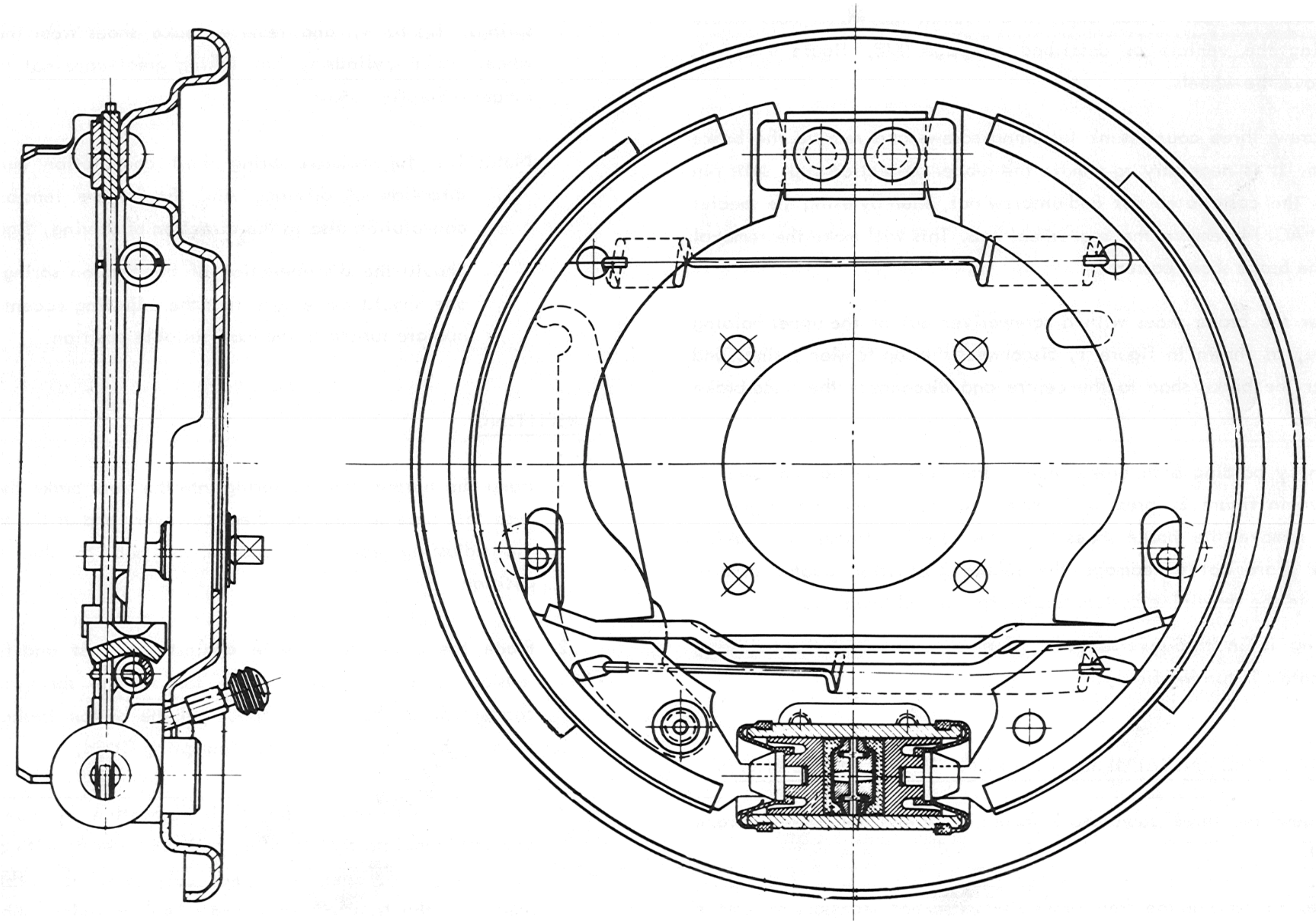
2. Lever with a screwdriver the brake shoes at the top and bottom from their bearing points, disconnect both top and bottom tension springs, figure 4, and remove brake shoes from their respective wheel brake cylinders, but taking great care not to damage the rubber protection boots.

NOTE: The top tension spring short convolution must be in the direction of driving. And the bottom tension spring long convolution also in the direction of driving, figure 5.

Should the disconnection of the tension springs be difficult, one should make sure that the adjusting eccentric and wheel hub are turned to the most suitable position.

REFITTING

1. Hang the bottom tension spring into the front brake shoe hole, then push this shoe up into the wheel cylinder, and at the same time turn the. adjusting eccentric and wheel hub to the most suitable position.
2. Place the other brake shoe against the first and fit the bottom tension spring, figure 6. The top tension spring must now be connected to the brake shoe, and the bottom brake shoe pushed towards the centre and the tension spring fitted.
3. Fit the brake shoes into their respective cylinders, and then position them into their bearing position levering with a screwdriver, but during this operation great care must be taken to prevent damaging the tension spring and wheel cylinder rubber protection boots.



Check that the adjusting eccentric is turning freely and before refitting the brake drum check again all parts for correct seating. For instance the brake connection pipe must not rub on the wheel hub.

After fitting the brake drum, the brakes must be re-adjusted.

CHECKING THE BRAKE LININGS

If the linings are worn nearly flush with the rivets or are oily then new linings must be fitted.

If only one new brake lining is needed, it is essential to replace both front or both rear which ever the case may be. This will guarantee an even braking, note: the linings must be of the same manufacture.

REMOVING AND REPLACING BRAKE LININGS

(with brake shoes removed from vehicle)

1. Separate with care the rivets from the brake linings and shoes, on the inner side with a cross cut chisel and drive out with a punch. In doing so, take care not to damage the brake shoes.
2. Clean brake shoes and remove burr from the rivet holes.

   The quality and type of the Amphicar brake lining is Energit 415-5 H.

   For riveting the brake linings, use rivets B 4 x 7 DIN 7338/Ms 63.

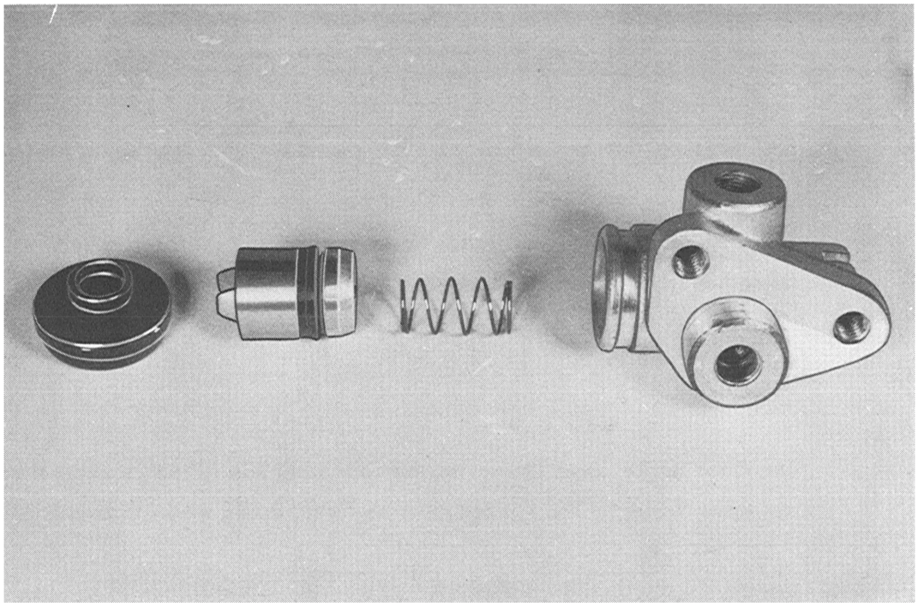
   Only original Amphicar Spare Parts should be used for repair work, these have been tested and proved to be correct and satisfactory.

   ATTENTION

   The front brake shoe lining of the rear wheel is 1,968" shorter than the other linings. The linings must be fitted as shown in figure 1.
3. Re-rivet new brake lining onto the brake shoe fastening from the centre and working outwards.

NOTE: In order to achieve an unobjectionable brake action and to avoid squeaking noises, be sure that the new lining bears onto the whole surface of the brake shoes, and does not protrude laterally. Avoid any tension, insert rivets vertically.

On no account should the brake lining sharp end edges be chamfered off. This sharp edge is necessary to help dry out the brake drums after water use by applying the foot brake several times.



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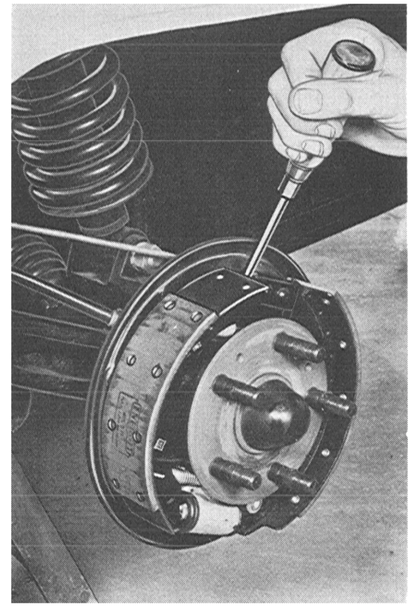

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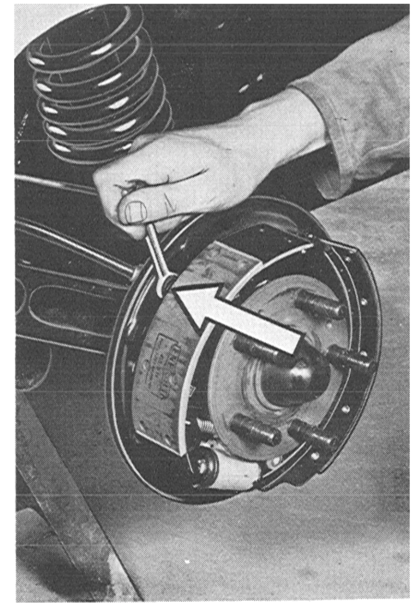

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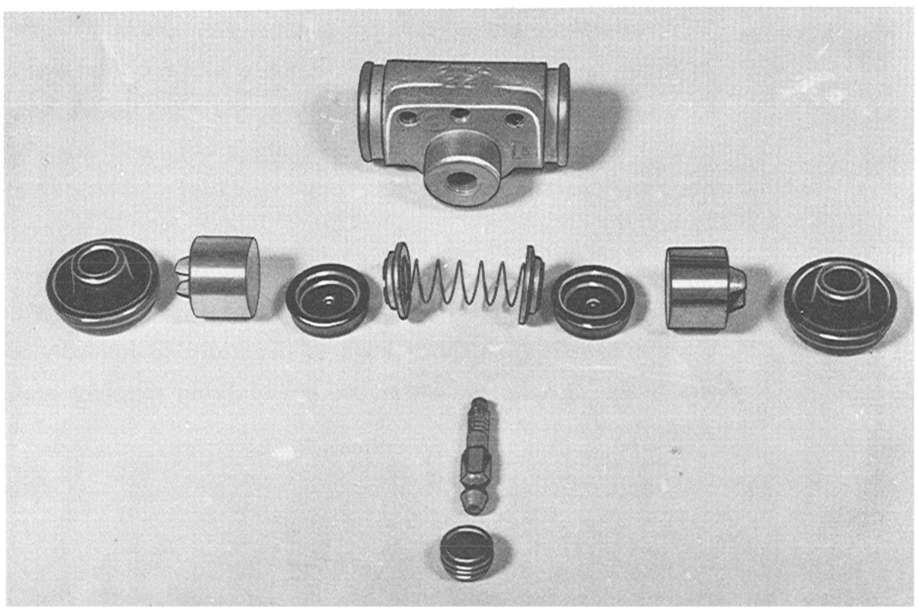

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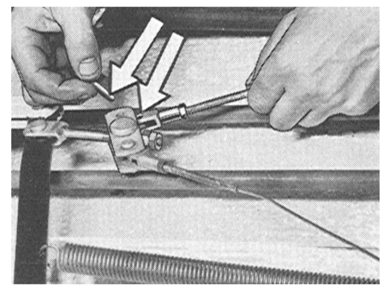

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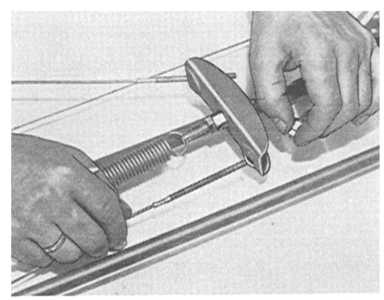

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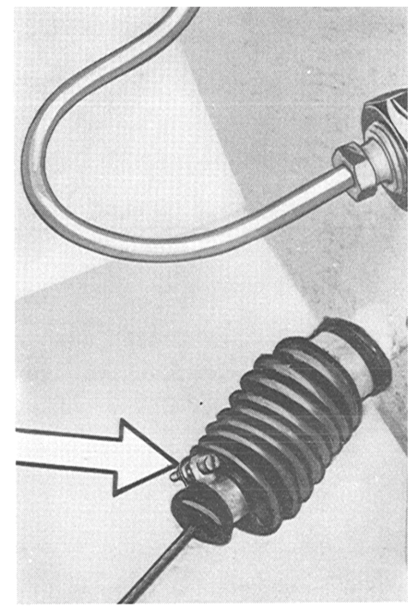

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INSPECTION OF THE WHEEL CYLINDERS

DISMANTLING

1. To dismantle the wheel cylinder, remove the rubber boot together with the piston, piston cup, pressure plug and compression spring.
2. Inspect the interior surface of the cylinder and the outside surface of the piston.

   Should the cylinder bore not be smooth, then the complete cylinder must be replaced.
3. Check the compression spring for condition; deformed springs must be replaced.
4. Should it be found after cleaning and checking all parts, that the cylinder and piston are in order, the piston cups should still be replaced.
5. The cylinder rubber boots must be carefully checked; if damaged, water would enter the cylinder and cause corrosion.
6. When reassembling the wheel cylinder, attention must be paid to the lubrication of the parts. These should be lightly smeared with cylinder paste.

Figure 1. Shows a dismantled front wheel cylinder.

Figure 4. Shows a dismantled rear wheel cylinder.

HAND BRAKE CABLE REMOVAL

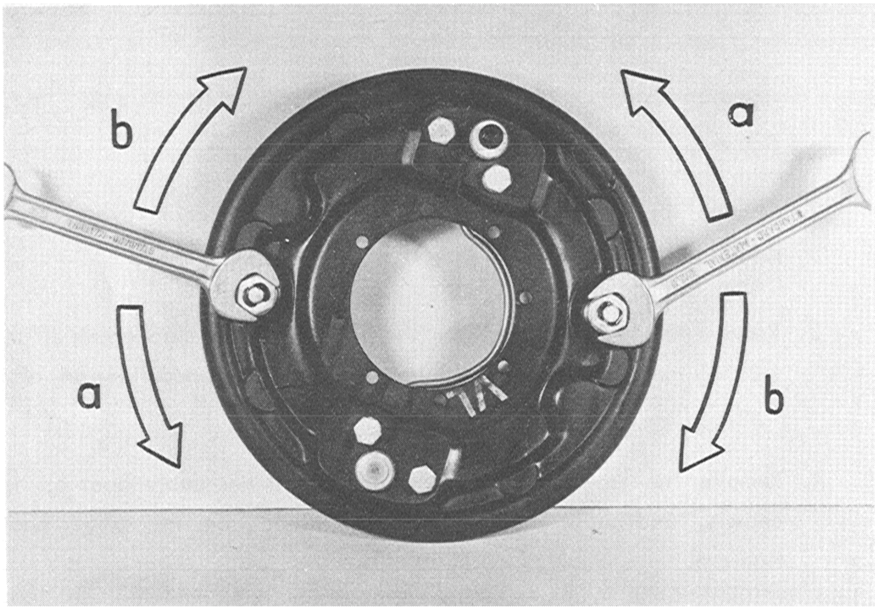
(with brake shoes on).

1. After removing the brake drum and the brake cable from the rear wheel, the brake shoe must be lifted out of its bearing position, figure 2, to unscrew the fastening bolt of the brake cable, figure 3.
2. Remove the rear and front seats, rubber mat, gear lever, knobs, rubber grommet, floor pan covering and rear seat base.
3. Remove the brake cable from the link joint, by slackening off the locking nut, figure 5a. Figure 5b shows the modification after Chassis No. 103 001.
4. Remove the front Norma clip from the rubber cable boot on the chassis, and draw the split interior piece from the rubber boot, figure 6.
5. Remove the brake cable sleeve from the chassis and pull the brake cable out.

NOTE: Check the brake cable for damage or wear, replace if necessary.

Also before refitting the cable, it should be smeared with a thin coat of Multi-purpose grease and attention must be paid, to ensure that the rubber cable boot on the chassis is water proof and in the correct seating position, for example when the hand brake is pulled to the "on" position the rubber cable boot must not be strained.

It is advisable after completing the repair to make a test water drive, with the vehicle floor pan covering still removed. This will help to make sure the rubber cable boots are water tight.



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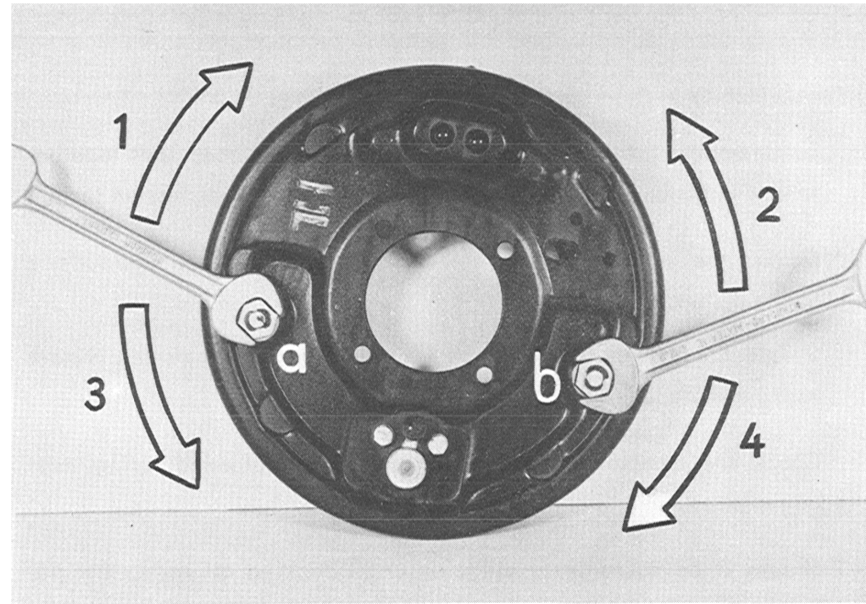

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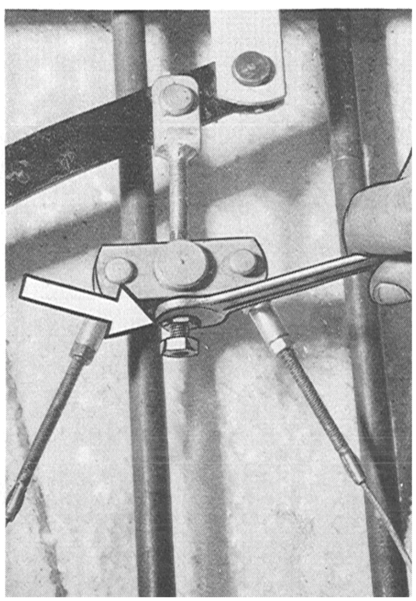
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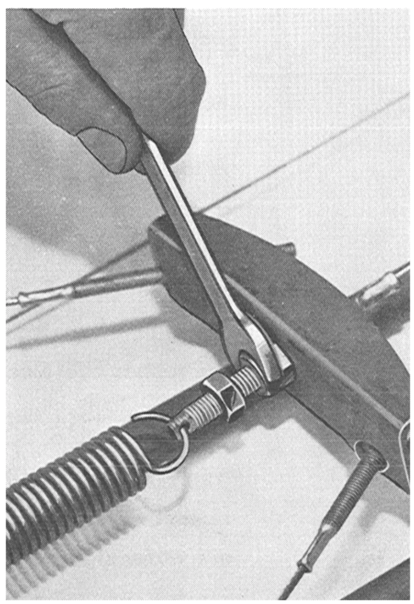
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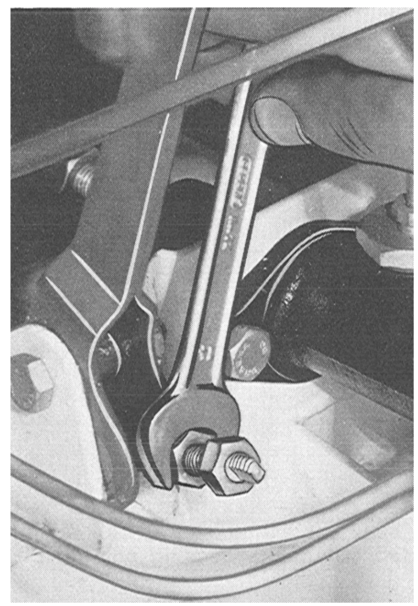
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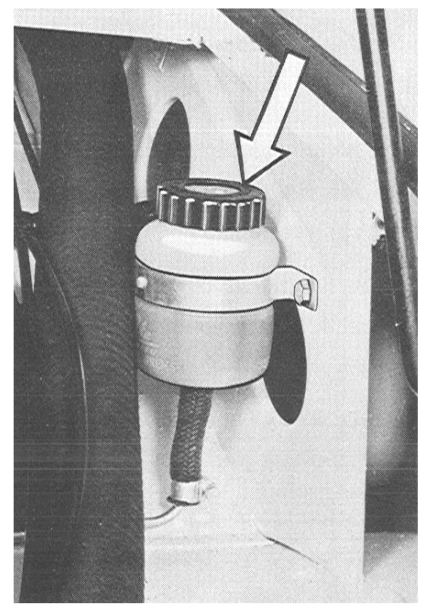
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ADJUSTING THE BRAKES

As all friction brakes entail wear of the brake linings, mechanical adjustment of the brake shoes is required from time to time. The Hydraulic Brake system provides automatically for adjustment to such an extent as permitted by the available master cylinder volume, that means, so long as the foot brake pedal distance from the floor has enough reserve.

Should the pedal when depressed be less than 1/3rd of pedal distance from the floor, then adjustment is necessary.

For adjusting. The vehicle must be raised, so that all four wheels can turn freely. On each wheel anchor plate are two eccentrics for adjusting.

The brake shoes must in each case be tightened fully in firm contact with the brake drums, and then be loosened until the drums are just able to turn freely.

The front wheels have a Duplex brake, and both eccentrics must be turned in the same turning direction; to tighten, turn anti-clockwise, figure 1a, and to loosen, turn clockwise, figure 1b.

The rear wheel brake adjusting eccentric a, (1) must be turned clockwise, and eccentric b, anti-clockwise (2) to tighten a firm contact to the brake shoes with the drums, figure 2. By slight reverse turning (3 and 4) of the eccentric the shoes are released from the drum until the drum can be turned without audible rubbing.

Upon completing the adjustment on all four wheels, the brake pedal must be vigorously depressed in order to centre the brake shoes in the brake drums. Adjustment must never be performed with the brake drums heated, or the hand brake applied.

After depressing the brake pedal the second or third time, the pedal distance must be shorter.

The adjustment of the hand brake takes place on the brake balancing piece, and should only be adjusted after the wheel adjustment has been carried out, figure 3.

Figures 4 and 5 shows modification after Chassis number 103 001 (two possibilities of adjustment).

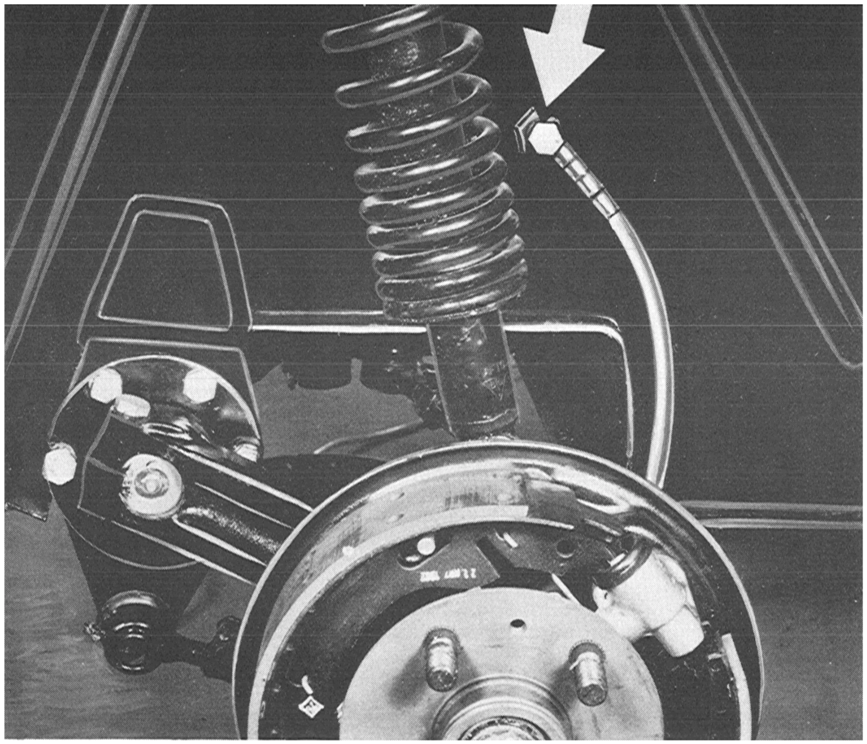
BLEEDING BRAKES

If in the case of repairs to the brake system the master cylinder or wheel cylinders, brake lines or brake shoes are disconnected or are replaced, it is most important to bleed the brake system.

Furthermore, it is necessary to bleed the system if the brake pedal can be depressed entirely without any resistance being felt, or it has to be depressed or "pumped" repeatedly for one braking. If the braking system has to be bled several times it is necessary to localize the trouble and remedy it. It is possible that the wheel or master cylinder rubber collars have loosened. Furthermore, air may enter the brake lines and brake hoses at their connections, or if one of the lines has become slack at the screw connection.

For testing the braking system for leaks, fill the fluid container, figure 6, with brake fluid, actuate the brake pedal and keep it depressed for about 2 minutes, so that a fluid pressure will be created within the brake system.

During this test the connections, brake lines, brake hoses, wheel and master cylinder should be observed so that the leaks can be easily found.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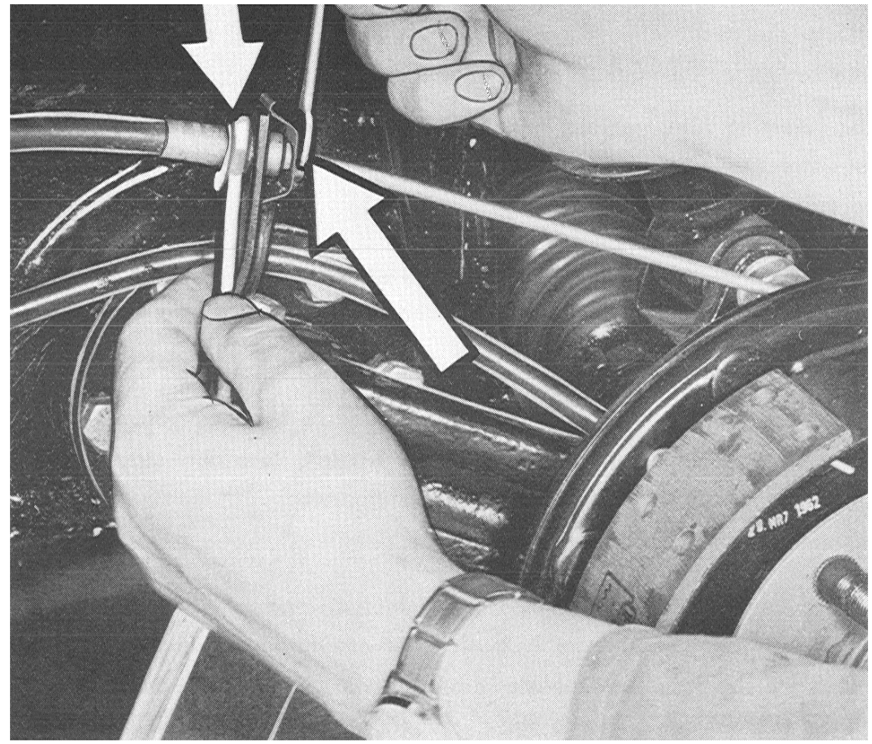
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1. Remove the brake fluid container cap and fill the container with fluid.

   ATTENTION

   On no account re-use drained off brake fluid, for there is the possibility of foreign matters entering the brake system, which could cause damage or blocking of the brake system.

2. Commence bleeding the brakes at the wheel positioned farthest away from the master cylinder.
3. Clean connection fittings, remove rubber cap from bleeder valve. Attach bleeder tube to bleeder valve. THE TUBE MUST HANG SUBMERGED IN A CLEAN CONTAINER, PARTIALLY FILLED WITH BRAKE FLUID DURING THE BLEEDING OPERATION.
4. Unscrew bleeder valve three quarters of a turn with an open wrench, fully depress the brake pedal, then slowly release pedal until it is in the fully released position.

   Continue operating pedal until liquid, containing no air bubbles, emerges from bleeder tube. Close bleeder valve.

5. Remove bleeder tube and replace rubber cap on the bleeder valve.
6. Repeat bleeding operation on the remaining wheel cylinders if the entire system is to be bled.
7. Check brake fluid in reservoir and replenish if necessary, fluid level should be approx 3/4 of an inch under the cap.
8. Finally check the brake action, by making a short road test.

   After depressing the brake pedal 1/3 of its pedal distance then the brake efficiency should be obtained. After each water drive apply the foot brake lightly several times to make sure they are holding. This procedure will dry the brakes and bring them back to their normal efficiency.

BRAKE HOSE

The brake hoses front and rear should be checked at each maintenance inspection. Figure 1 shows the correct fitting of the front brake hose.

Removing rear brake hose, figure 2.

Should damage be found on any brake hose, then a new one must be installed, and the cause for damage repaired.

BRAKE DRUMS

Whenever brake drums are removed, they should be inspected for scores, deep grooves, cracks and out of round.

Cracked drums must be replaced, out of round or slightly scored drums can be turned in a Lathe, but the surface must be smooth to ensure a longer life of the brake linings.

Oversize brake linings must be fitted for re-bored drums.

The maximal bore diameter of the drum must not be over 9.145" + 0.008". Original bore diameter of drum is 9,055".

On no account should too much metal be removed, for this would weaken the drums and cause inefficiency in the braking system.

REPLACING DRUMS

Whenever new drums are to be fitted, the braking surface of the drums must be thoroughly cleaned to remove the rust proof coating.

AMOUNTS OF TORQUE TO BE APPLIED TO SCREW CONNECTIONS

1. Torque for screw connections with copper gasket rings
   (Hose sleeve, inserts and threaded connections)
2. Torque for screw connections without copper gasket ring
   (Example. Bleeder valve, lines with taper end piece, and brake hoses)

Thread (pitch in mm)	Torque in ft.lbs. for screw connections			
	1. with gasket ring		2. without gasket ring	
	minimum	maximal	minimum	maximal
M 6	7,2	8,6	1,1	1,8
M 7 x 1	8,6	10,1		
M 8	11,5	13,7	1,8	2,9
M 10 x 1	9,4	10,8	3,6	5,4
M 10 x 1,25	13,7	16,6	4,3	6,5
M 12 x 1	11,5	13,7	1,8	2,9 with interior taper
M 12 x 1,5	18,0	23,0	5,8	8,6
M 14 x 1	14,4	17,3		
M 14 x 1,5	21,6	25,9		
M 16 x 1,5	25,2	30,2	8	10,8
M 18 x 1,5	27,4	32,4		
M 22 x 1,5	41,8	50,4		

Torque in ft.lbs. for Stop light switch

Thread	Torque in ft.lbs.
M 10 x 1 k	7,2 - 10,1

MEASUREMENTS FOR MASTER AND WHEEL CYLINDERS,

HOUSINGS AND PISTONS

Owing to regular operation of the brake system the main and wheel cylinders also cylinder pistons suffer from a natural wear, which if very badly worn, could cause inefficient braking.

Permissible cylinder and piston diameter measurements have been stipulated. Should the bore diameter be found larger than stated, then the cylinder housing must be replaced. Or if the piston diameter after checking is found to be smaller than stated, then a new piston must be fitted.

To check the piston diameter for size and roundness use an outside micrometer.

The cylinder housing shows less wear as a rule, and is best checked with an inside caliber or with an inside micrometer.

MASTER CYLINDER

Nominal diameter	7/8"
Maximal permissible housing diameter	0.877"
Minimum permissible piston diameter	0.867"
Maximal permissible play	0.011"

FRONT WHEEL BRAKE CYLINDER

Nominal diameter	13/16"
Maximal permissible housing diameter	0.817"
Minimum permissible piston diameter	0.807"
Maximal permissible play	0.011"

REAR WHEEL BRAKE CYLINDER

Measurements and play are the same as the master cylinder.

TROUBLE SOURCES AND CORRECTIONS

In the following trouble chart, instructions are provided for the Maintenance of the Hydraulic Brake System. This chart includes the common trouble sources, and correction of same.

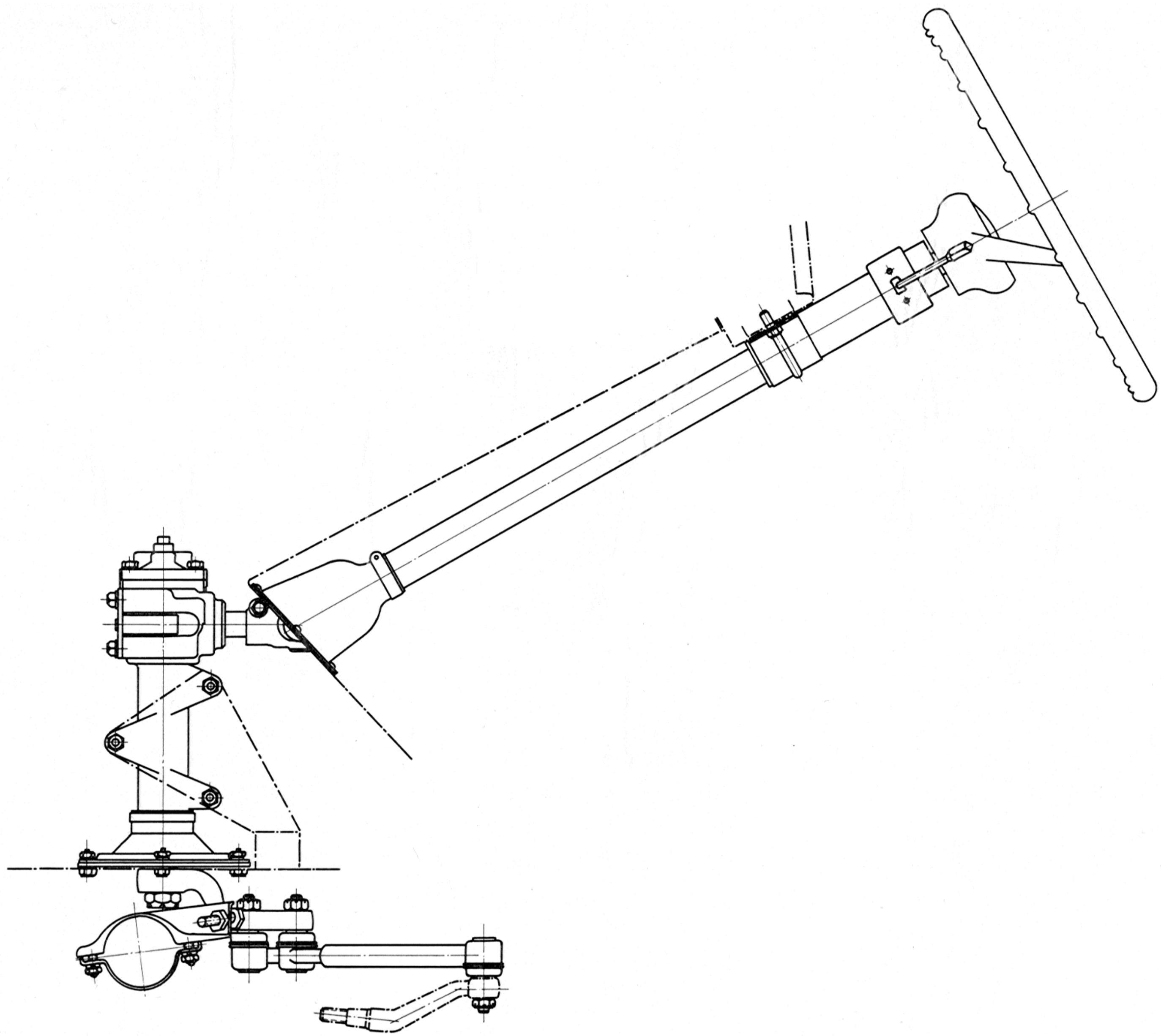
TROUBLE	CAUSE	CORRECTION
Brake pedal travel has become so great that pedal plate comes into contact with the floor board.	Worn brake linings.	Adjust brakes, do not adjust brake pedal.
Brake pedal encounters no resistance but instead may be depressed to a great extent with elastic action.	Air in the system. Too little fluid supply in the compensating tank.	Bleeding. Supplement brake fluid.
In spite of adjustment and bled brake, brake pedal can be depressed but no braking action is achieved.	Check whether valve in the master cylinder is damaged or seat of the valve is contaminated.	Replace check valve clean valve seat, use no sharp edged tools.
Braking action only after repeated depressing of brake in spite of replacement of the check valve.	Air in system. Seat of valve contaminated, return spring possibly fatigued.	Bleeding. Clean valve seat, use no sharp edged tools. Replace return spring.
The brake slackens and the brake pedal can be fully depressed within a short time after being adjusted.	Leaking lines or damaged and defective cups in the master or wheel cylinder.	The line must be sealed against leakage, damaged cups subjected to a check and possibly replaced.
Brakes heat up during travel.	Bypass bore in the master cylinder contaminated. Too little play between brake pedal and master cylinder piston. Return spring too weak.	Clean master cylinder. Adjust brake pedal. Install stronger return spring.

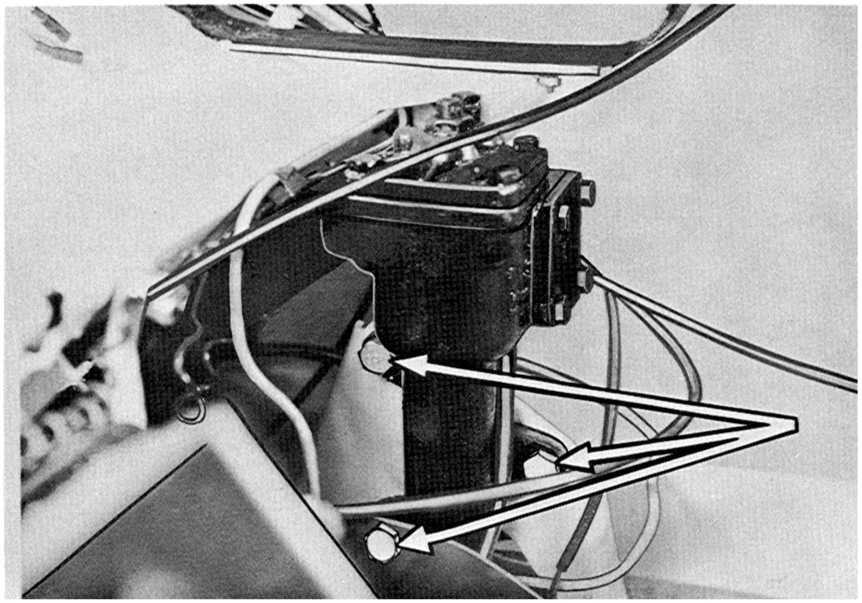
TROUBLE	CAUSE	CORRECTION
Brakes heat up during travel.	Rubber elements swollen by use of improper fluids	Drain fluid, remove all rubber elements, flush out system thoroughly with alcohol, replace rubber elements ,including check valve and valve seat rings.
	Brake linings rub continually on the brake drum.	Adjust brake eccentric, or check play between lining and drum; if necessary fit shoes correctly in the bearing point.
In spite of very high pedal pressure poor braking action.	Brake lining soiled by leaking wheel hubs or axle journal packing.	Repack wheel hubs and axle journals, replace brake linings (scrubbing of soiled linings with petrol or kerosene provides no remedy since linings continue to exude lubricant matter during braking action).
	Diminishing of lining coefficient of friction.	New linings, as a pair.
Brake acts by itself.	Bypass bore in the master cylinder is clogged. This can result from a swollen cup, use of improper fluid.	Bypass bore must be cleaned, and flush out brake line system with alcohol, insert new cup, pour in brake fluid, check and correctly adjust stop of brake pedal when pedal is in position of rest.
Brakes do not act uniformly.	Out of round brake drums.	Grind or turn brake drums to shape. In this process the drums must not be weakened. Possibly replace drums.
	Poor tires.	Replace worn tires.
	Soiled brake.	Replace all brake linings.
	Brake drums out of line.	Realign brake drums.
Brake rattles and tends to lock.	Protruding lining rivets.	Replace or re-rivet brake linings. Machine drums to shape.
	Return springs.	Replace return spring.

TROUBLE	CAUSE	CORRECTION
Squeaking brakes.	Out of round brake drums, brake drums out of line.	Machine drums to shape.
	Poorly adjusted brakes, dirt and dust in brakes.	Realign brake drums. Adjust brakes properly.
	Loose lining rivets.	Re-rivet, possibly replace linings.
In spite of slight pedal pressure vigorous braking action.	Brakes not properly adjusted., Backing plate loose on axle.	Tighten firmly.

STORAGE HINTS

1. Rubber parts of the brake system (collars and protecting caps) are subjected to atmospheric influences while they are being kept stored and become unserviceable after a longer time. Care should be taken to store them in a cool, dry and, if possible, dust free room.
2. Assembled wheel and master cylinders should not be kept stored longer than six months, and storage of collars and protecting caps should not exceed 12 months. If pre-assembled wheel and master cylinders should have been kept stored for a time longer than specified above, it is recommended to check that before fitting, parts are in a good and free working condition. All hardened rubber parts should be replaced.
3. The braking system should be checked at regular intervals according to the routine inspection scheme as specified in the Service Coupon Booklet.
4. After a longer time the brake fluid can become contaminated by abrasions of the rubber parts, therefore it is recommended to replace the brake fluid after 12 months use of the car.

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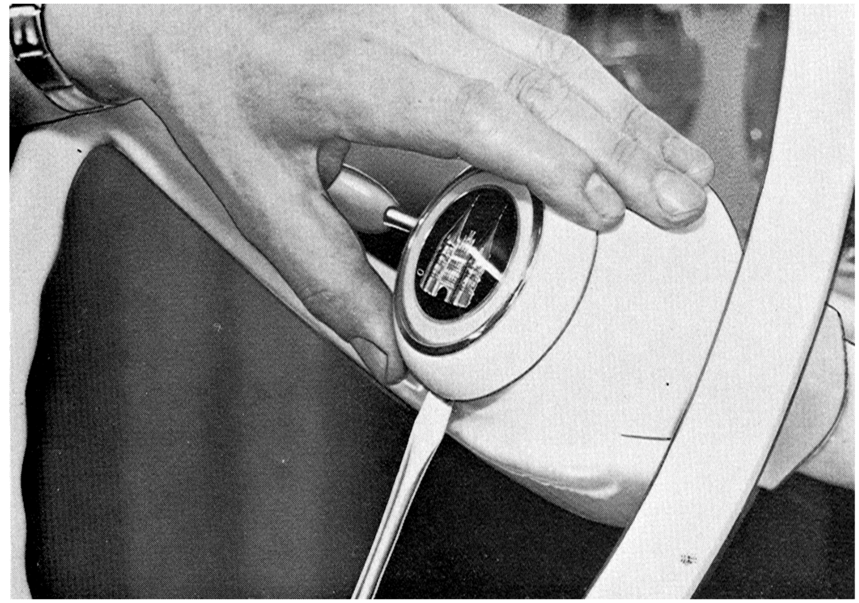
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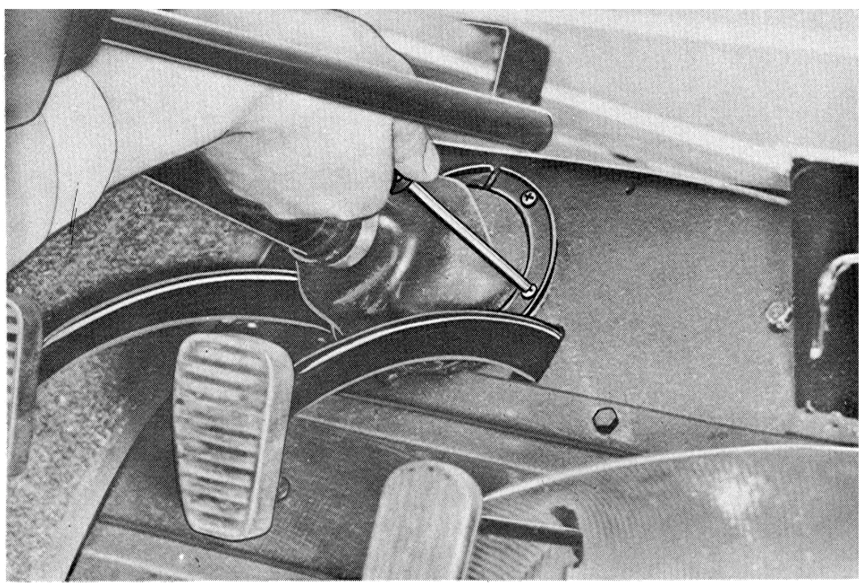
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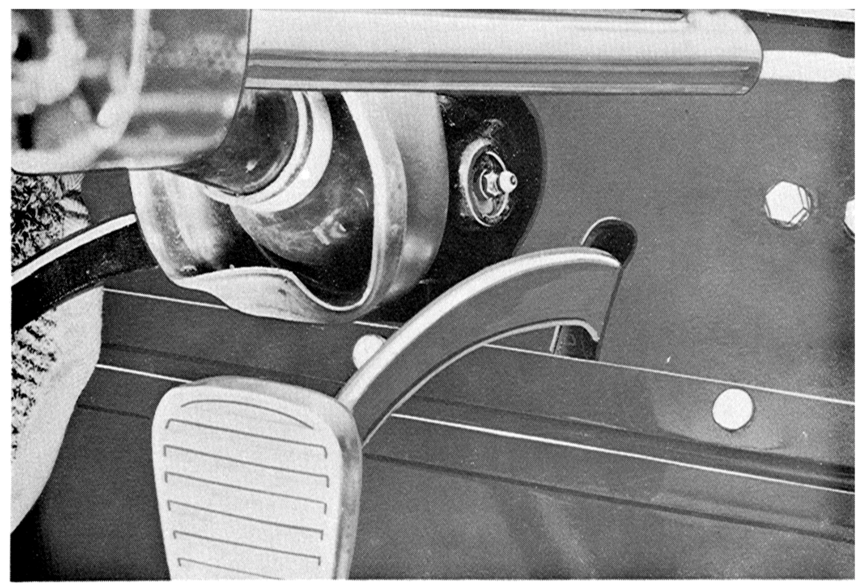
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STEERING

DESCRIPTION

The steering box, type Amphicar - ZF "Gemmer"-steering (model 7316975130) consists of the following main parts: the steering roller shaft with the inserted steering roller and the steering worm with ball races and ball cages.

The steering box is attached to the steering gear bracket, at the left front side of the longitudinal chassis member, and secured with three mounting bolts (Fig.1).

The steering assembly consists of two steering arms, two adjustable track rods, one lower control arm and two steering knuckles.

A waterproof rubber seal is mounted between the steering box and the lower steering arm and is secured with a flange and a clip to the bilge.

A universal joint is mounted between the steering column and the steering box, serving as an equalizer. This universal joint is protected by a rubber jacket.

Turning circle — 36 ft. 5 in.

LUBRICATION

Proper lubrication is the most important factor to insure trouble free functioning and long life.

The recommended lubrication for the steering gear-box is SAE 90 transmission oil.

These specifications are met by all high-grade brand-name oils. The oil level in the steering box must be checked at the pre-delivery inspection and thereafter every 6,000 miles. If necessary, add oil.

The steering column bushing require no special maintenance.

DISMANTLING THE STEERING GEAR

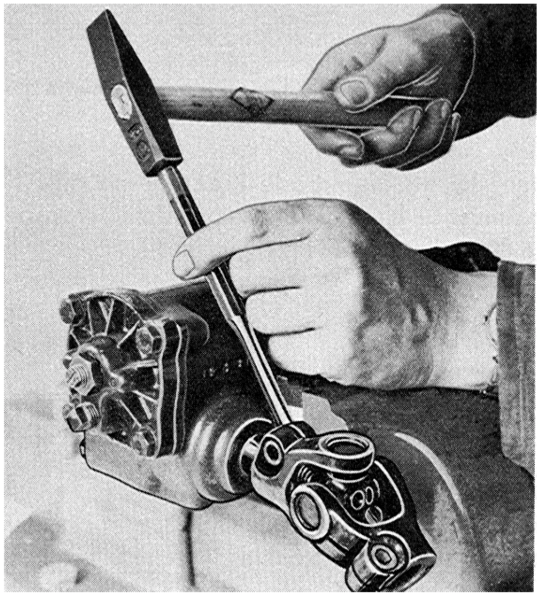
Disconnect the positive cable of the battery (at the ground connection).

Dismantle the complete horn button as follows:

Place a screwdriver into the notch provided under the button and push out the latter completely (Fig. 2). Disconnect cable.

In the passenger compartment, unscrew the six mounting screws on the rubber universal joint jacket and remove retaining flange (Fig.3). Pull up rubber seal so that the universal joint becomes visible (Fig. 4). Turn steering wheel to most favorable position, dismantle the locking plate and clamping bolt. Mark position of steering column in relation to the universal joint by a center punch mark.

Loosen securing screws of the steering column bracket under the instrument panel until it is possible to pull the complete steering column out of the universal joint splines without damaging the sheathing.



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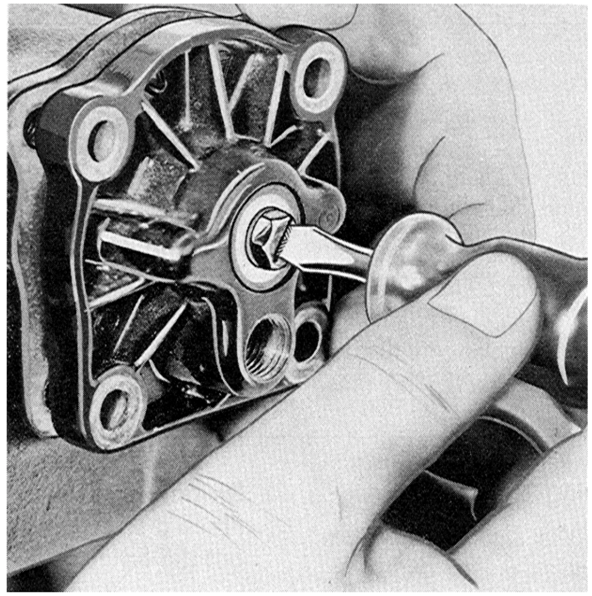

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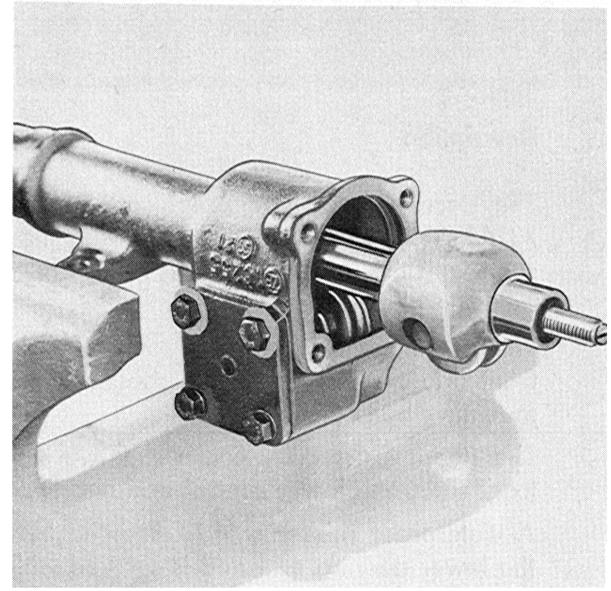

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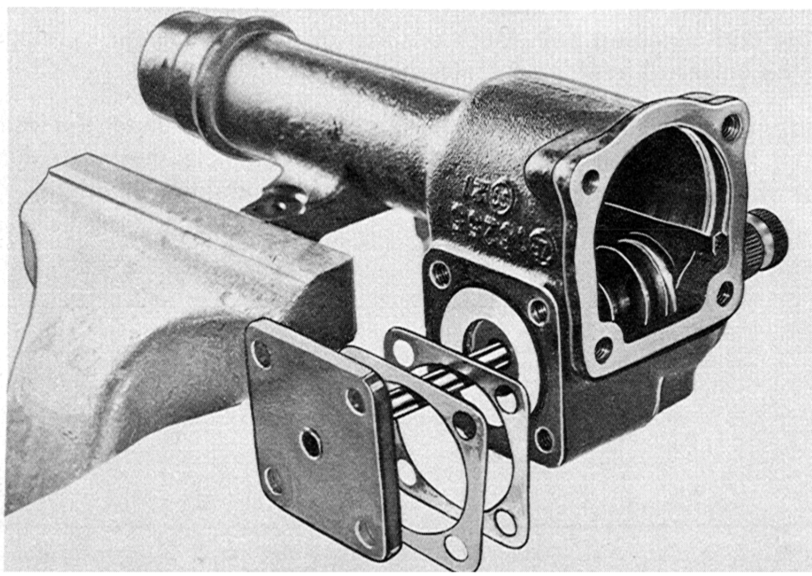

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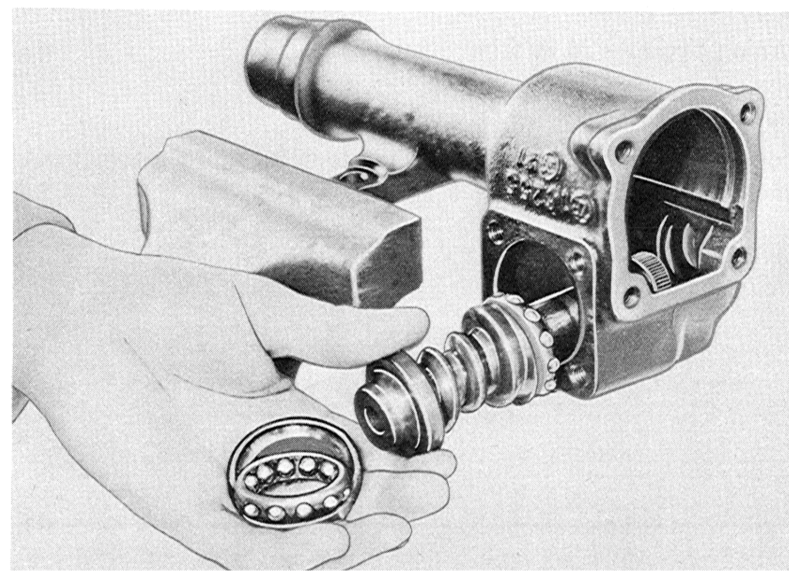

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If the complete steering column is also to be dismantled, remove the steering wheel with the aid of the special tool AC 21 (steering wheel extractor) and dismantle the steering column bracket.

Remove spare wheel cover and spare wheel from trunk. Pull the horn-cable out of the steering column.

Jack up front of vehicle or move it onto an inspection pit. Remove track rod housing cover plate.

Mark position of steering stop on axle tube. Dismantle steering stop. Take split pin out of castle nut of lower control arm. In the trunk, dismantle the three securing bolts of the steering box and the clip of the rubber seal.

Lower control arm and the steering roller shaft of the steering box are punch-marked. Before removing the lower control arm, check if the mark is clearly visible or, if necessary, punch-mark again.

Turn steering box to most favorable position for putting on special extractor tool AC 23.

Remove lower control arm. Under no circumstances may the lower control arm be removed by hammer blows or by driving a wedge between the housing collar and the lower control arm, as this may cause serious damage to the steering box.

In the trunk, turn the steering box so that the universal joint becomes loose at the tank and the steering box may be removed without damaging the rubber seal.

Mark the position of the universal joint (Fig. 1) and dismantle.

DISASSEMBLY OF THE STEERING GEAR

Loosen oil seal cap and drain old oil.

Loosen mounting screws of the housing cover, dismantle lock nut of the adjustment screw and turn the adjustment screw into the cover (Fig. 2).

Remove cover.

Take out steering roller shaft (Fig. 3).

Open retainer ring and remove adjustment screw with guide washer from steering roller shaft bore.

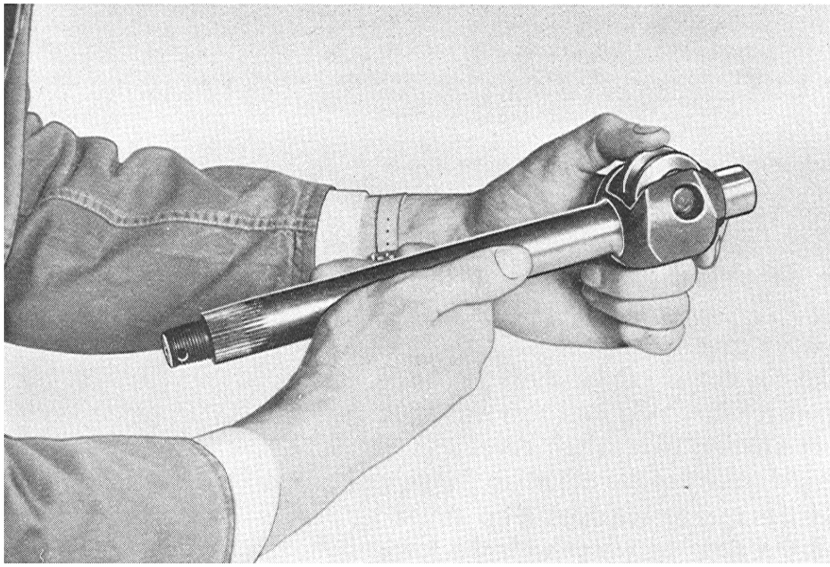
Loosen screws of the adjusting flange and take off the adjusting flange and the spacer washers (Fig. 4).

Pull the steering worm with the lower ball race out of the housing (Fig. 5).

The circlip, located in the base of the worm gear and the centering ring should only be removed if the circlip packing washer is damaged or if leakage or corrosion is observed on the oil gauge tube.

CHECKING OF THE PARTS OF THE STEERING

The bearing supports of the steering roller shaft must not show excessive wear.



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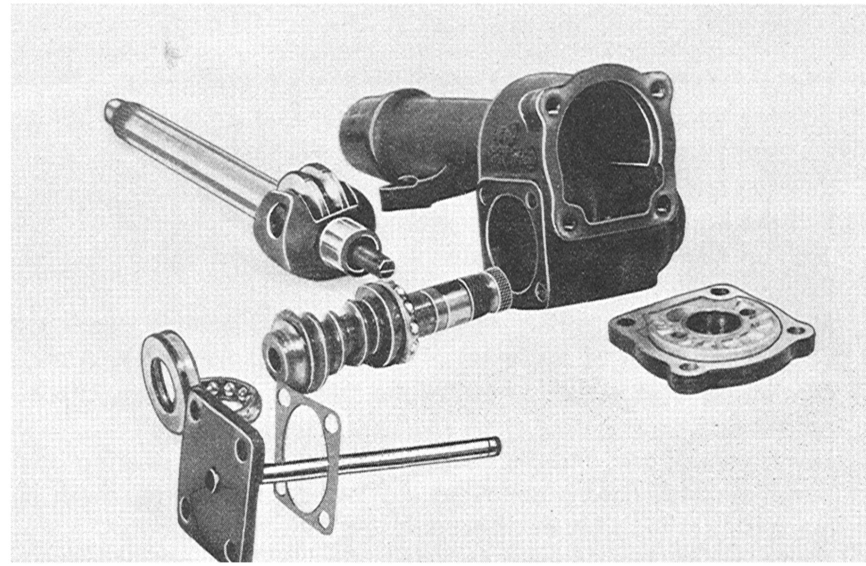

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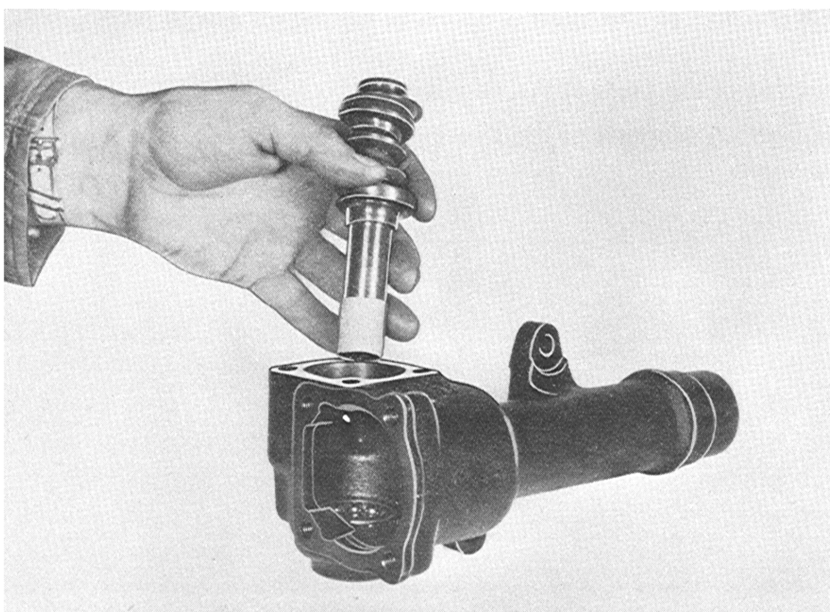

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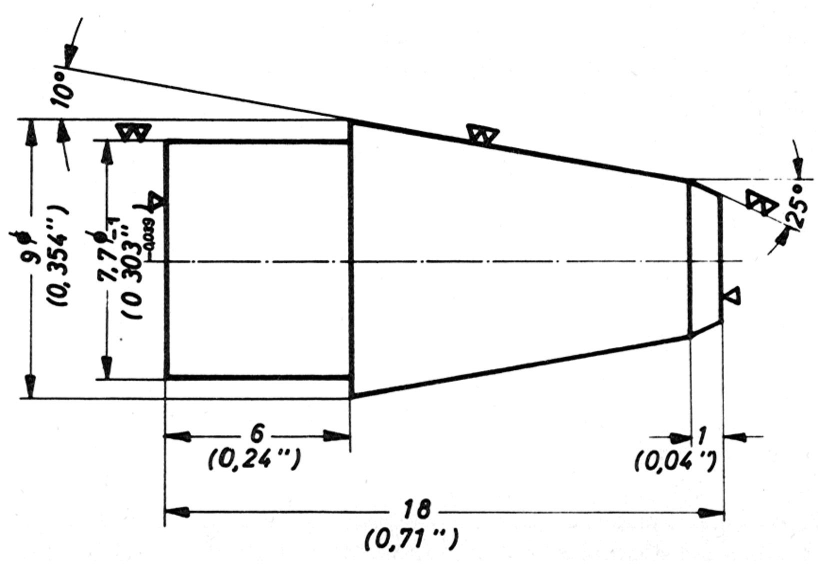

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The steering roller rests on a needle bearing in the head of the steering roller shaft. The precision of the parts is of particular importance for correct steering operation.

The steering roller must not have any play whatsoever (Fig. 1).

The steering roller is constructed in the form of a double-toothed roller, pivoted on a single needle bearing. The needle bearing absorbs the radial forces. The steering roller pin is secured at both ends by a special method at the time of manufacture and must not be dismantled under any circumstances.

Side play is absorbed by honed plates, between which the steering roller is accurately fitted.

To ensure smooth movement free from play, the assembly of these parts required a maximum of care and of precision.

For reasons stated above, damaged parts of the steering roller shaft must not be replaced. If main parts of the steering become defective, it must be replaced in its entirety, in order to assure smooth and reliable operation.

When checking the steering roller shaft, the spiral of the worm must be inspected for wear, nicks or other damage.

The ball races of the steering worm must not show any pitting. The balls, cages and the outer ball races must be checked for indentations and pitting.

Carefully check all parts of the steering for wear or damage.

Fig. 2 shows the disassembled steering box.

RE-ASSEMBLY OF THE STEERING GEAR

The dismantled shaft seal rings must be replaced by new ones.

Place first shaft seal into housing collar with the seal lip facing inside. Install second shaft seal with the seal lip pointing outward and fill the space between the seal with grease.

Press ball race into housing.

Place a ball cage on the upper track of the steering worm and insert into housing together with worm. Use assembly sleeve (or heavy oiled paper) to protect the shaft sealer ring (Fig. 3).

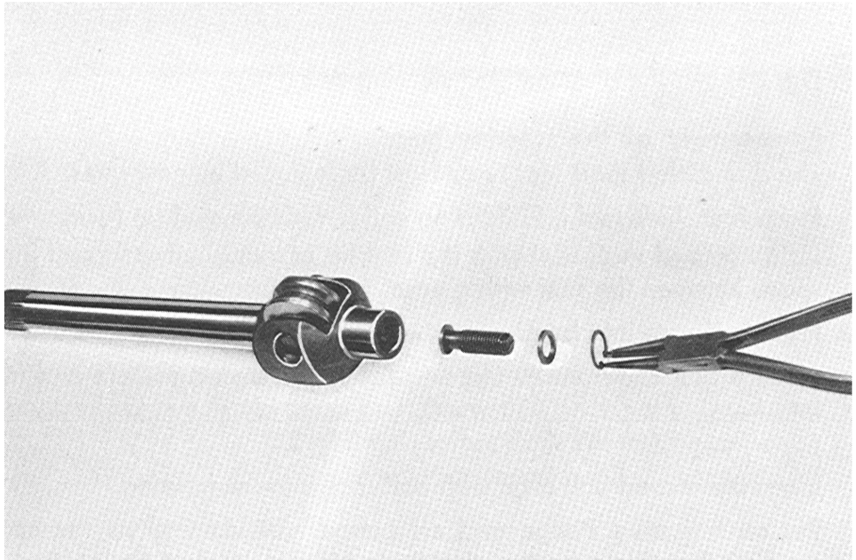
Insert the second ball cage with ball race into the housing.

Put on adjusting flange and oil gauge tube as well as the spacer washers. For this operation the guide pin (Fig. 4) must be inserted into the oil gauge tube to avoid damage to the seal and support ring, also to prevent pushing these out of position.

Tighten diagonally opposite screws.

When in position, check that the worm gear is free from play. For this purpose a torque measuring gauge is placed on the spiral worm gear which is then turned one full revolution in both directions and adjusted to a torque of 7.2-18.0 ft./lbs.

If this is not the case, a correction must be made by means of suitable spacer washers.



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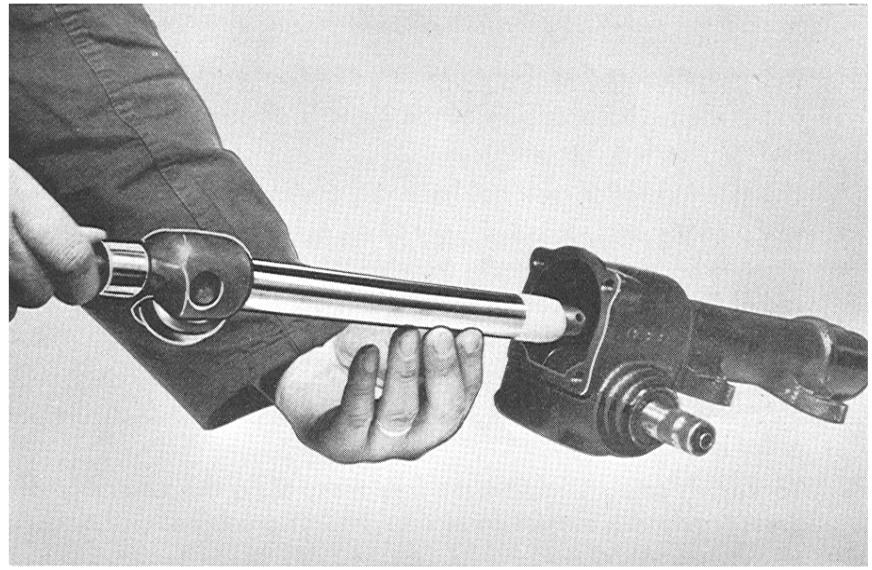

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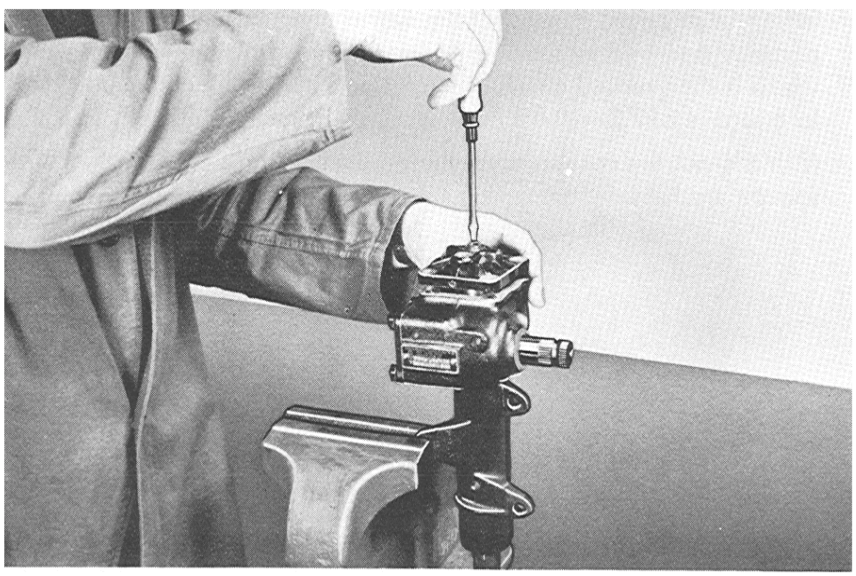

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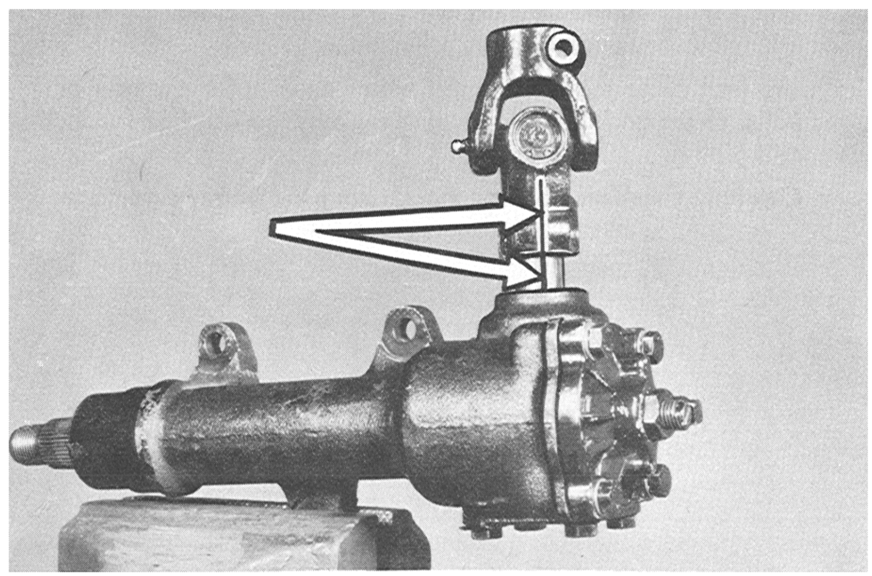

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The spacers are available in thicknesses of 0.004" —0.005" —0.006" —0.02" so that with a correct choice of washers the prescribed torque can be achieved.

After taking this measurement, the remaining two securing screws, with spring washer and locking plate, respectively, are screwed in and tightened. (Two screws are secured with locking plates and two with spring washers.)

Insert adjustment screw and guide washer into the bore of the roller shaft and insert circlip (Fig. 1). Measure the end play of the adjustment screw. The play must not exceed 0.002". If in excess, use a thicker guide washer.

Carefully insert the steering roller shaft into the housing, avoiding damage to the shaft seal (Fig. 2). It is recommended to use an assembly sleeve or heavy oiled paper to protect the shaft seal.

Place spacer shim on the plain surface of the housing and fit housing cover.

Insert adjustment screw counter-clockwise into the tap hole of the housing cover. Tighten until the cover lies on the sealing surface of the housing (Fig. 3). Insert the mounting screws, with spring washers., and tighten.

ADJUSTMENT OF THE PRESSURE POINT MUST BE MADE WITH THE WHEELS IN THE STRAIGHT AHEAD POSITION.

Place torque measuring gauge on the spiral worm gear.

Turn adjustment screw clockwise until a slight resistance is felt.

Tighten adjustment screw in this position with lock nut.

Move steering worm, from the central position, one full turn in both directions.

In the central position adjust to a torque of 72 to 115 ft. lbs.

This may be corrected by turning the adjustment screw clockwise or anti-clockwise.

Fill steering box with SAE 90 transmission oil.

Replace filler plug.

Place universal joint onto the gearing of the steering worm (paying attention to alignment marks!) and secure (Fig. 4).

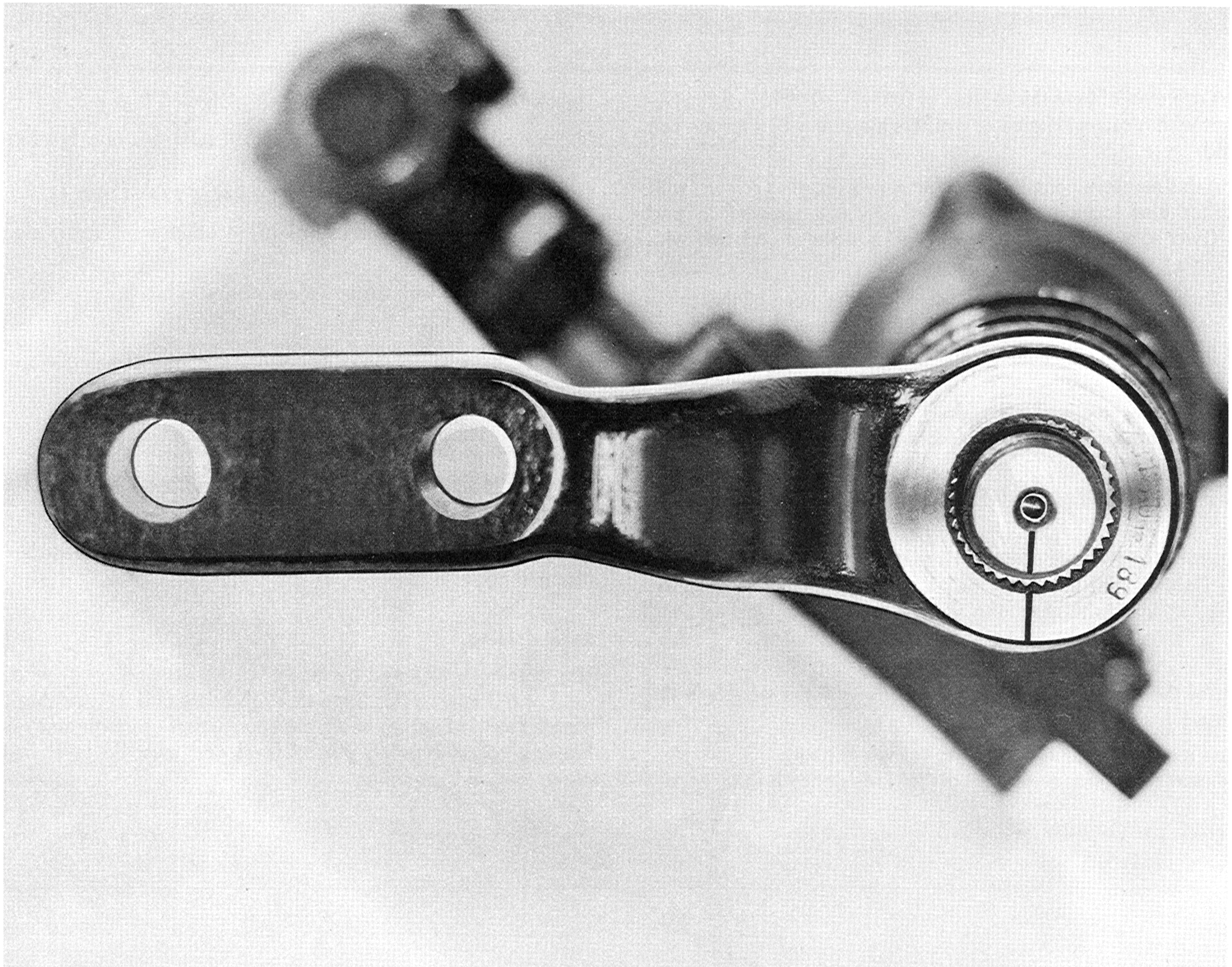
INSTALLATION OF THE STEERING BOX

Before installing the steering check the rubber seal in the trunk floor. A defective or porous rubber seal must be replaced.

The installation of the steering box is done in reverse order from the dismantling.

Special Note:

The steering is fastened by means of the housing collar which has the form of a flange; it has three through-bores and its fastening plane lies parallel to the bearing neck. The counterpart of the three eyelets of the housing collar must be placed level and must lie level in the same plane to avoid spanning.



A universal joint is mounted between the steering column and the steering box. The prescribed angle of 290 must not be exceeded when assembling.

The lower control arm is linked with the steering shaft by means of a conical spline. It is tightened and held by the castle nut.

When tightening, note the position of the lower control arm in relation to the steering shaft.

It is marked by a groove on the control arm and on the front end of the steering shaft (Fig. 1).

The spline and the thread of the steering shaft must be oiled with engine oil before inserting the control arm. Only thus can the lower control arm be placed in its correct position on the conical spline and fit properly.

The castle nut is screwed on and must be tightened to have a torque of 79.2 ft.lbs. The torque mentioned applies to the oiled spline and thread. The castle nut must then be secured with a split pin.

Check the left and right end stops by turning the steering wheel. Under no circumstances should the steering gear be hit or forced when positioning.

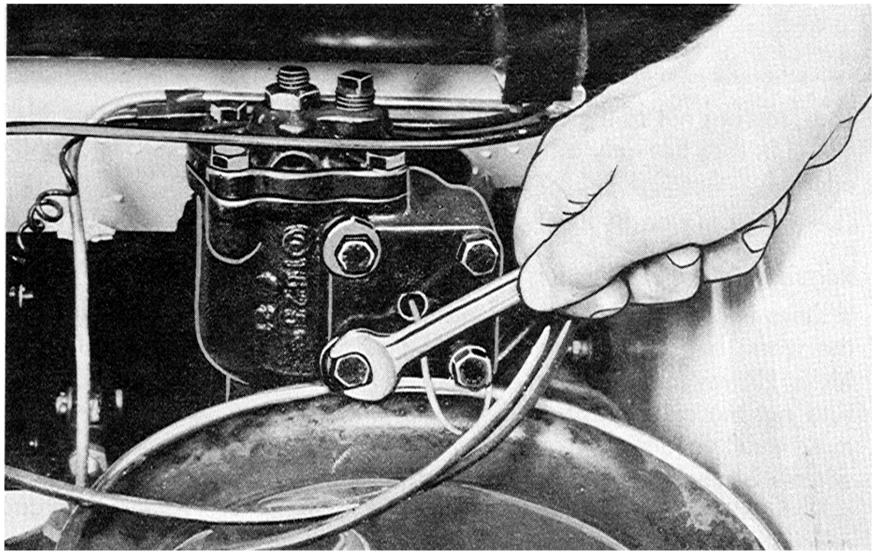
The securing nut of the steering wheel is tightened to a torque of 36—43—2 ft. lbs., but only after the thread and the taper have been lightly oiled.

The measuring of the front axle is described in group 5, pages 12 to 17.

REGULATING AND READJUSTING OF THE INSTALLED STEERING GEAR

If there is play between the steering worm and the steering roller and the worm bearing, this can quickly and easily be adjusted in the vehicle. However, before any adjustment of the steering box is made, find out the exact position of the play. Adjustment by trial and error may result in damage and high repair costs. Wobbling of the front wheels is never caused by the steering. Attempts to correct it by tight adjustment of the steering are successful for only a very short time and are damaging to the steering box. Quite often, the cause of the complaint can be found in the excessively wide play of the ball pivot of the axle journal bearing or similar.

Non balanced wheels are quite often the cause of wheel patter which can result in either excessive tire wear and/or stress on the steering gear, even if it cannot be felt at the steering wheel. Therefore, ensure that all wheels, including the spare, are correctly balanced both dynamically and statically.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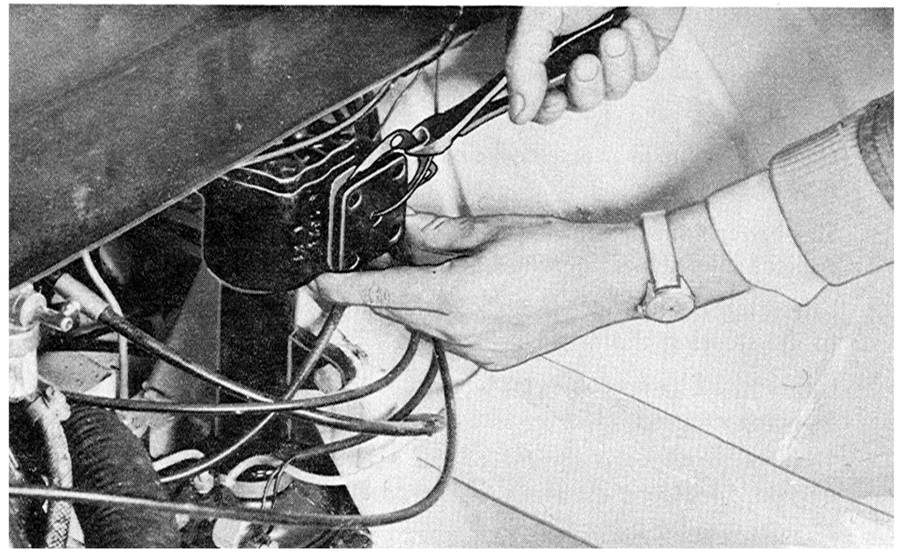
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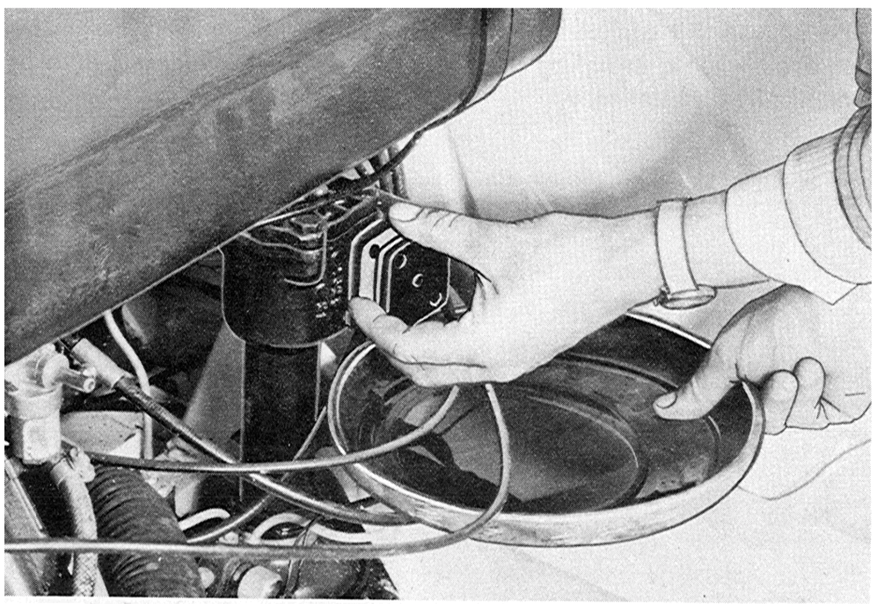
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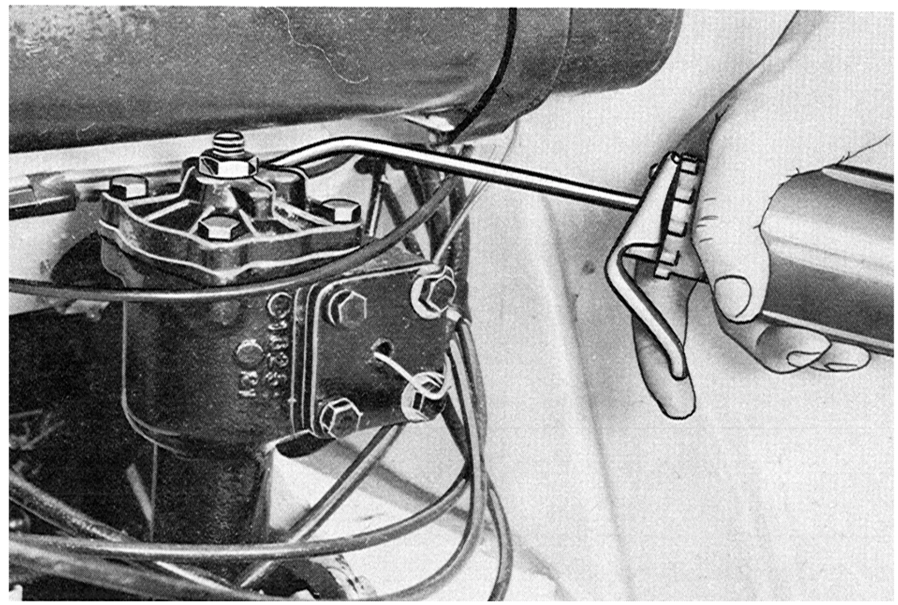
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All adjustments of the steering must be made with the front axle jacked up.

Experience has shown that wear and tear occurs primarily in the range of the straight-ahead position. The pitch diameter of the worm is, therefore, slightly larger than the turning circle of the steering roller. Thus it is possible to keep the middle range free from play at all times, without evoking any wedging in the end positions. The play present outside the middle position is normal and can be disregarded. When driving, the front wheels always strive to return to the straight-ahead position. So, here too, the steering roller always rests firmly on the inner flank of the worm, assuring trouble-free steering.

The adjustment of the play between the worm and the steering roller shaft, respectively, must always be made in the straight-ahead position. Prior to adjusting this play, if any, check if the worm bearing is free from play, correctly as necessary. To regulate or adjust the worm bearing, the steering wheel must be turned to the right, about one revolution, from the straight-ahead position. In this position, the worm cannot be pressed sideways by the steering roller shaft into its bearing, which would simulate freedom of play.

The first inspection or adjustment, respectively, of the play in the steering should be carried out after the first 350 miles at the earliest, but not later than after 1,000 miles. It is recommended that further inspections and adjustments, if required, be carried out at intervals of about 6,000 miles.

ADJUSTMENT OF THE PLAY IN THE WORM BEARING

Any play present can be noticed with the fingers at the steering column stump, where it leaves the steering box, when the lower control arm is being pushed to and fro.

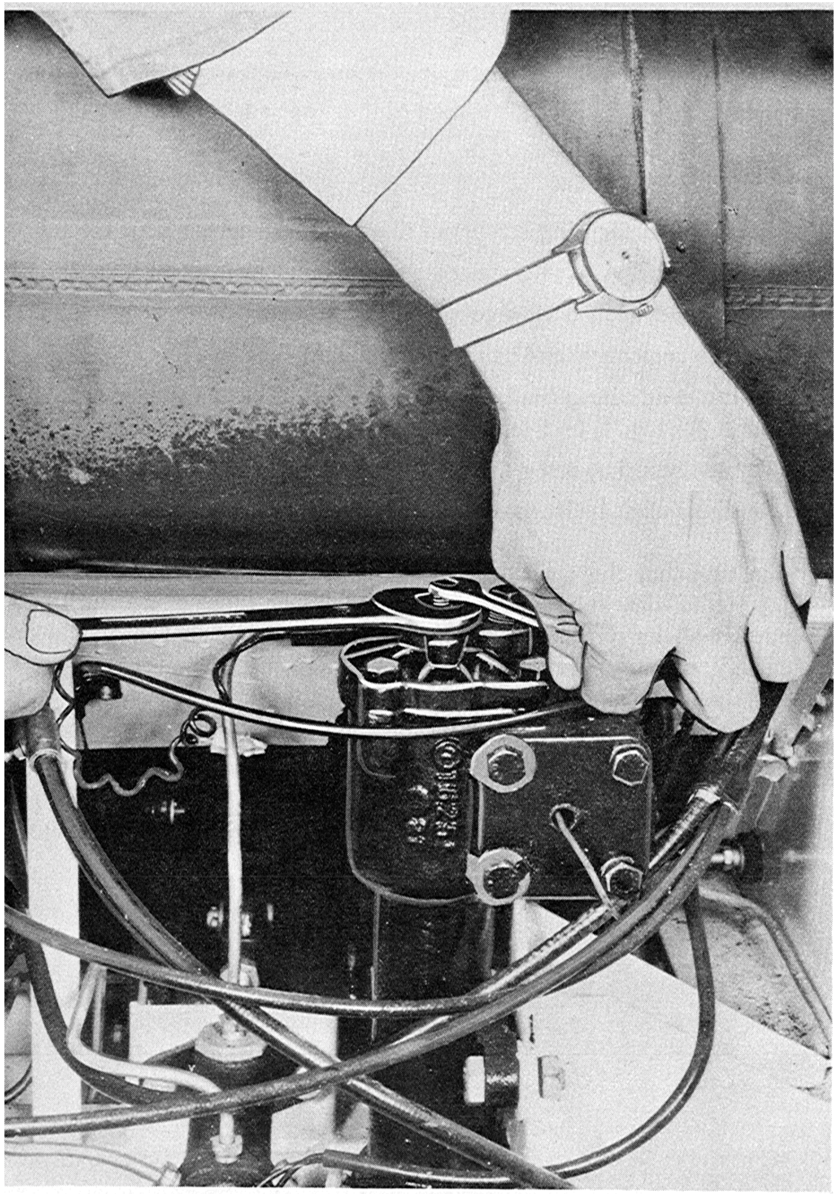
The adjustment is done by selecting the proper spacer washers at the adjusting flange which in fastened at the front end of the steering box.

MAKING THE ADJUSTMENT

1. Remove the securing screws of the adjusting flange (Fig. 1).
2. Pull back adjusting flange, catching the out flowing oil (Fig. 2).
3. Disconnect horn button cable and pullout.
4. Add or remove shims as required (Fig. 3).
5. Re-insert adjusting flange with guide tool in the oil gauge tube. (See page 7/6 Fig. 4) and remove guide tool from universal joint.
6. Tighten securing screws.
7. Refill oil (Fig. 4). Transmission oil SAE 90.

Make sure that the adjusting flange is always tightly fastened to the shim plate (with the screws), to assure proper functioning and water tightness of the steering gear. Tighten the securing screws evenly and carefully, checking that the steering worm remains free to rotate at all times. The bearing must never be set too tight, as this would cause damage. If required, insert a shim plate of suitable thickness.

When the worm bearing is properly adjusted, a torque of 7.2 to 18.0 ft. lbs. should be measured at the steering column. When this measurement is taken, the steering roller must not be engaged with the worm.



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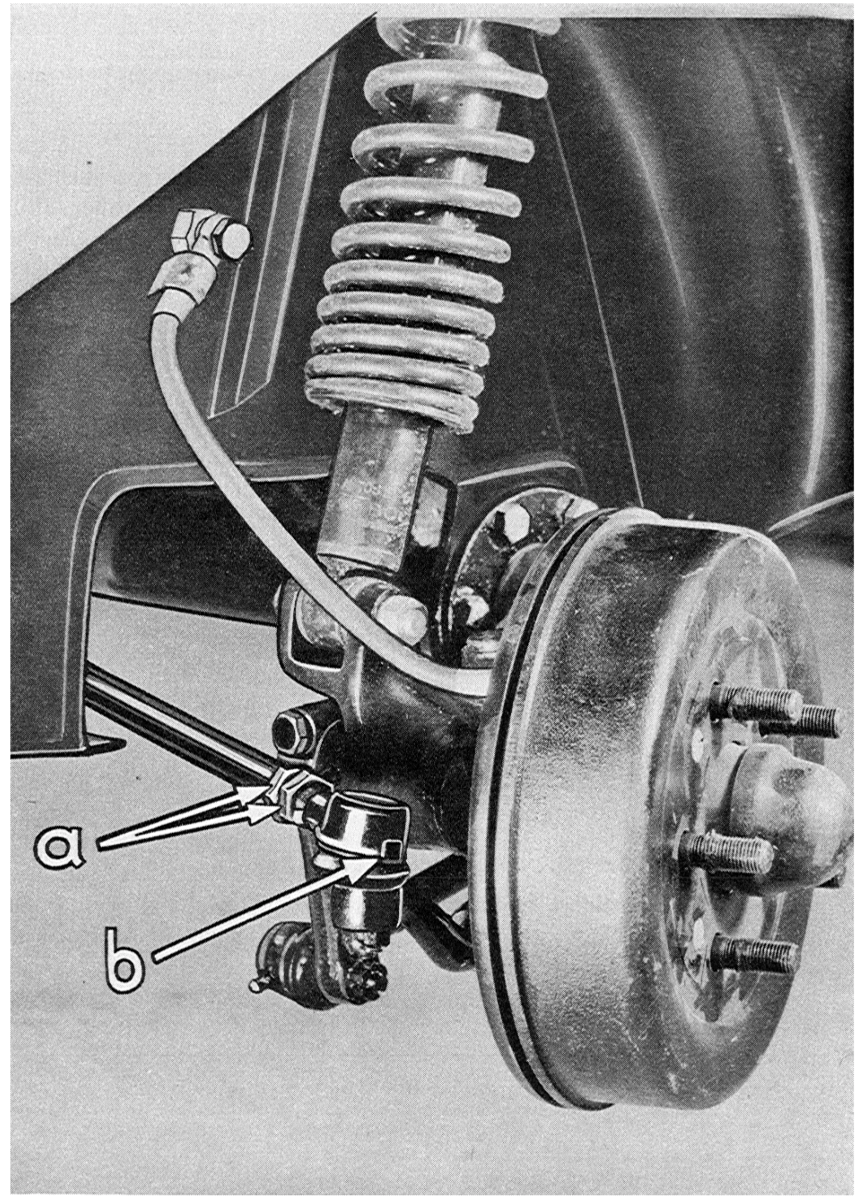


ADJUSTING THE PLAY BETWEEN THE STEERING WORM AND THE STEERING ROLLER SHAFT

The adjustment is carried out as follows:

1. Place steering in straight-ahead position.
2. Loosen lock nut of the adjustment screw (Fig. 1).
3. Turn adjustment screw clockwise until there is no more play. Check by pushing lower control arm to and fro.
4. Tighten lock nut, holding adjustment screw with an open wrench.
5. Turn steering wheel a full revolution in both directions. A slight resistance in the middle range should be felt only when the steering wheel is turned with one finger. If possible, check with torque measuring instrument.

The adjustment has been done correctly, when, in the central position, a torque of 72 to 115.2 ft. lbs. is measured at the steering column.

A tighter adjustment will not improve steering conditions, but it will considerably affect the efficiency and the longevity of the steering, since it prevents the formation of an oil film between the engaged parts.

TRACK RODS

The two track rods connect the lower control arm with the steering arms. Each track rod consists of a threaded tube and a threaded ball joint yoke.

The tube is secured in position at each end by a nut, a lock washer and a lock nut (Fig. 2 a).

The ball joint yokes are protected against dirt and water damage by a rubber cup, this being secured by a wire clamp (Fig. 2 b).

If excessive play is found in one of the ball joint yokes, or if a damaged ball pin is detected, the complete ball joint yoke must be replaced.

For adjusting, bend back the lock washer tabs on the track rods, loosen the lock nuts and adjust the track by turning the tube in or out (left hand and right hand thread).

When dismantling the track rods use special tool AC 24 to extract the exterior links. If difficulties arise when dismantling the inner links, loosen the steering box (as described under "Dismantling of the Steering Box") and extract the lower control arm with the special tool AC 23.

When work on the steering assembly is completed, measure the front axle as described in 5/15.

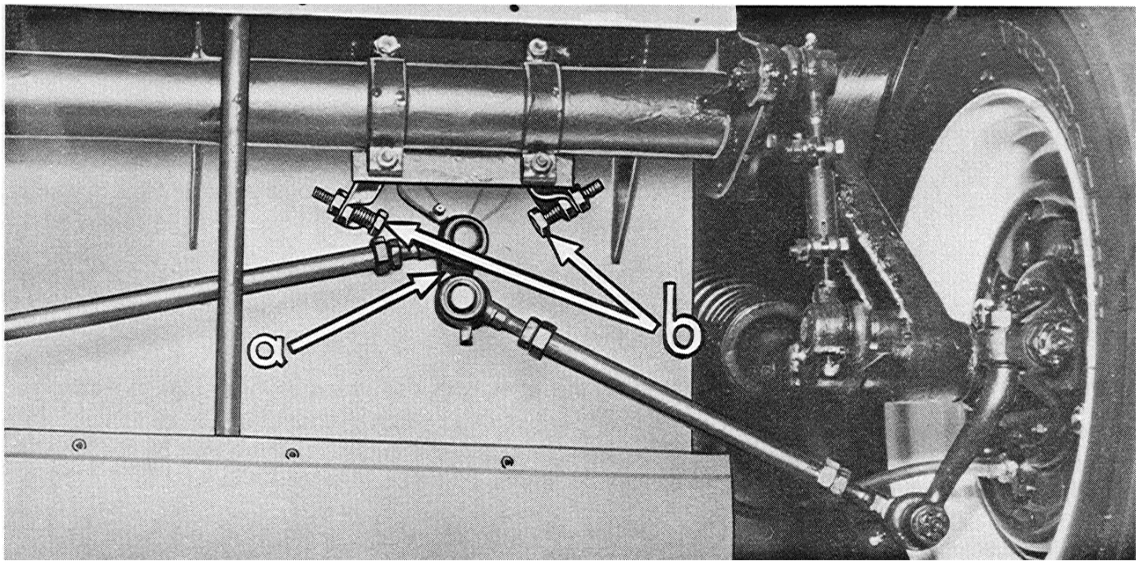
The initial measurements of the track rods are:

Right hand	49-1/8" +/- 3/8"
Left hand	13-3/8" +/- 3/8"

The nuts of the ball joints yokes must be tightened to a torque of 32.4 ft. lbs. and secured with a split pin.

The steering arms are pivoted in the axle journal with a Woodruff Key. The castle nut must be tightened to a torque of 50.4 ft. lbs. and secured with a split pin.

The steering stop, consisting of the top cover with the stop screws and clamping brackets, is fastened to the front cross connecting bar (axle receiver).



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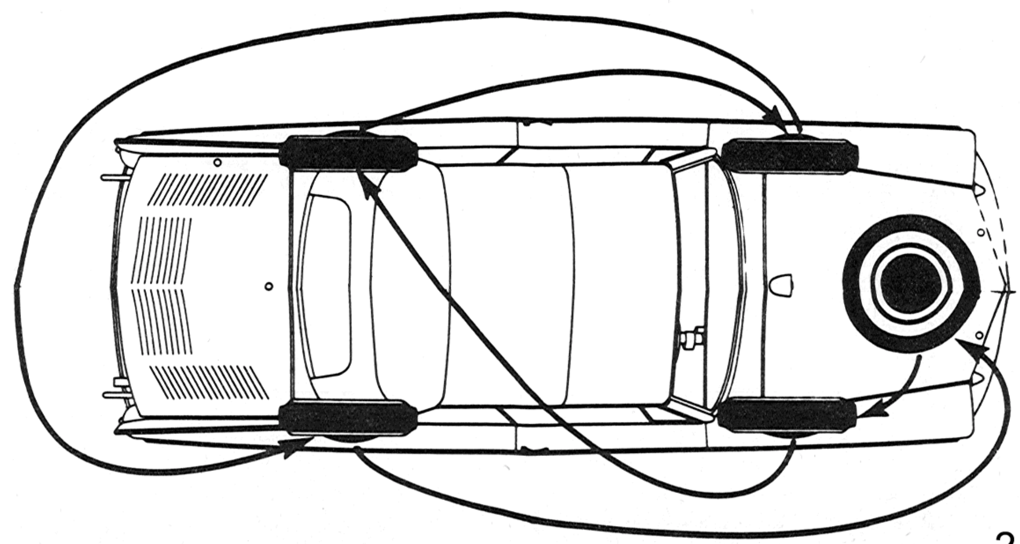

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When the steering is in the straight-ahead position, the lower control arm points backward. (Fig.1 a).

When mounting the steering stop make sure that the center of the lower control arm coincides exactly with the center between the steering stops.

The stop screws (Fig. 1 b) must be adjusted so that the wheels will move freely at a distance of 3/8" from the body, upon reaching the left or right-hand stop.

REPLACING THE STEERING COLUMN RUBBER SEAL IN THE TRUNK FLOOR

If the seal is found to be defective, dismantle the steering (as described on page 7/3). Dismantle nuts and flange for rubber seal and remove. Reassembly must be effected with very great care to assure perfect tightness against water leakage.

WHEELS -TIRES

Disc Wheel	4.5 j X 13
Tires	6.40-13

To assure comfortable driving and good road-holding of the Amphicar, it is necessary to check the disc wheels and tires regularly.

If the wheels are out of balance, the reason may be as follows:

Side play of the disc wheels
(caused by bumps against obstacles);

Vertical play of the wheels
(caused by irregularities of the disc wheels or of the tires);

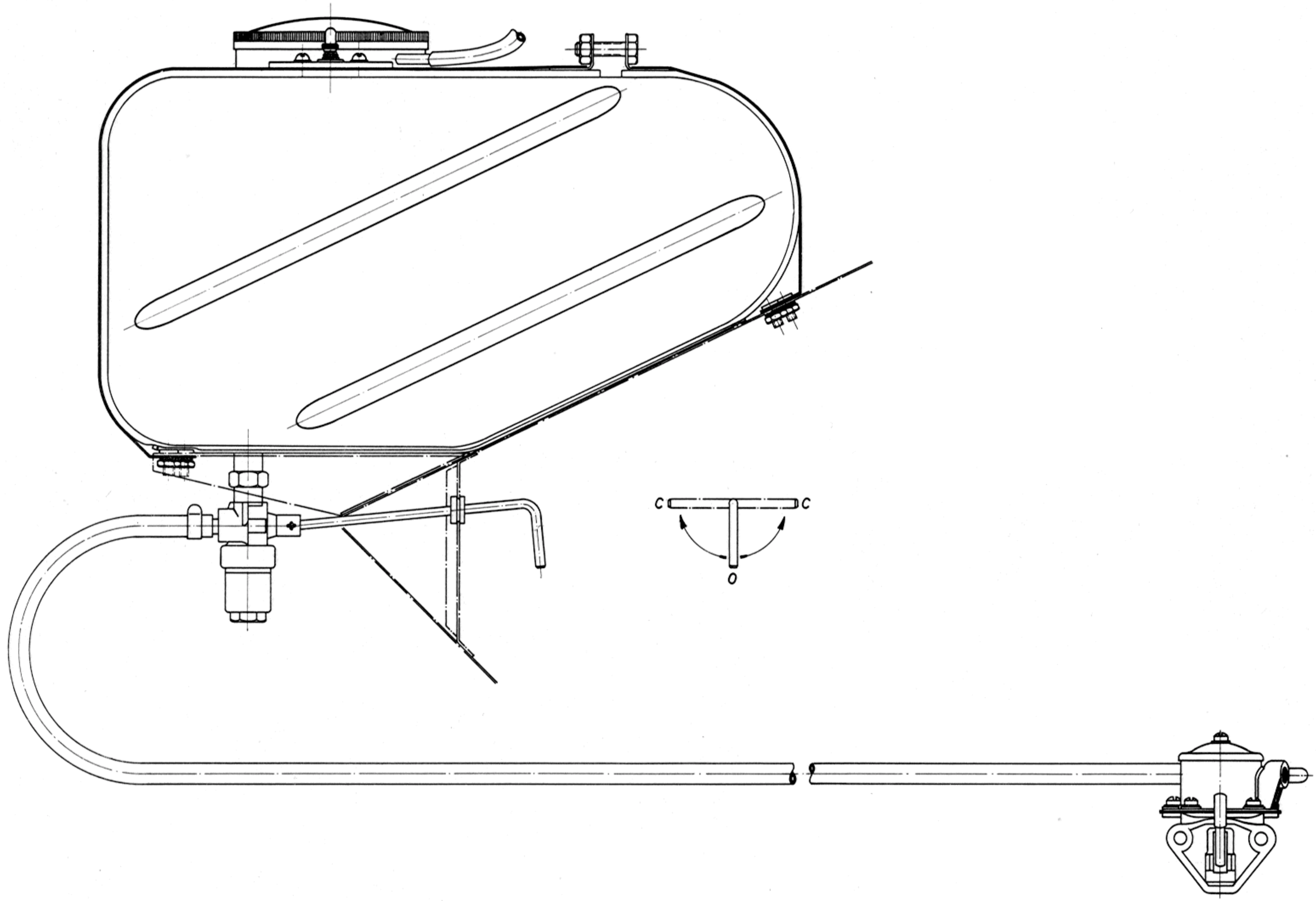
Static imbalance
(uneven distribution of weight).

While the side and vertical play of the tires and disc wheels can be found with the aid of a surface gauge, the imbalance of the wheels can only be found with the aid of a wheel balancing machine.

TIRE PRESSURES

Front	14 p.s.i.
Rear	30 p.s.i.

Correct tire pressures must be maintained constantly, as too high a pressure results in very hard driving and in excessive tread wear. The case of the tire is destroyed prematurely if the tire pressure is too low. Wheels must be rotated every 6,000 miles (Fig. 2).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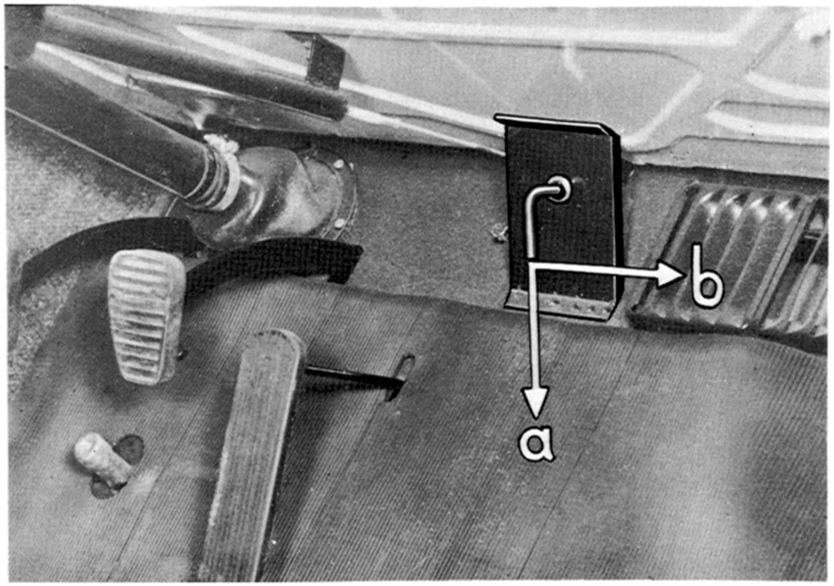

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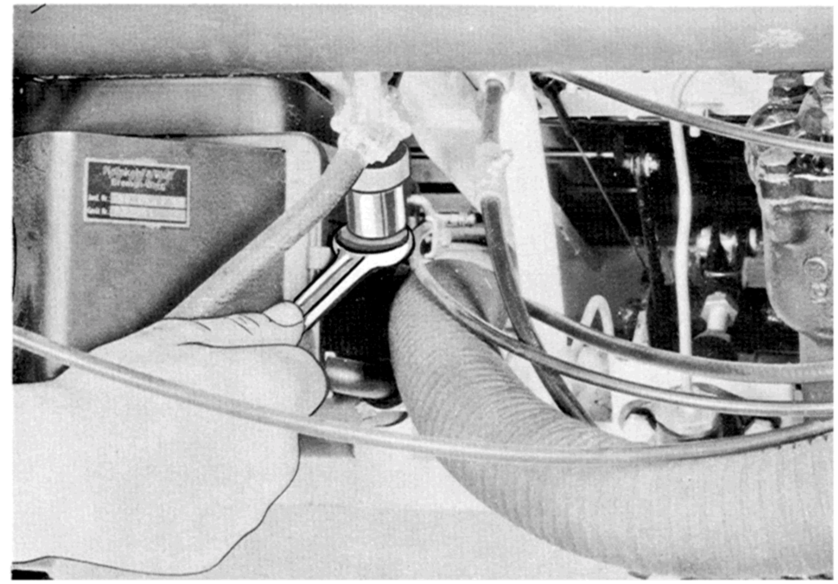

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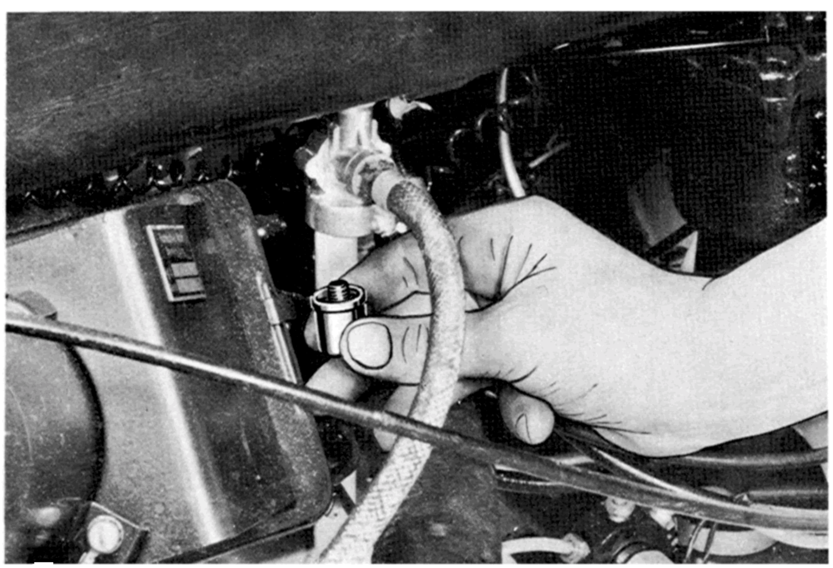

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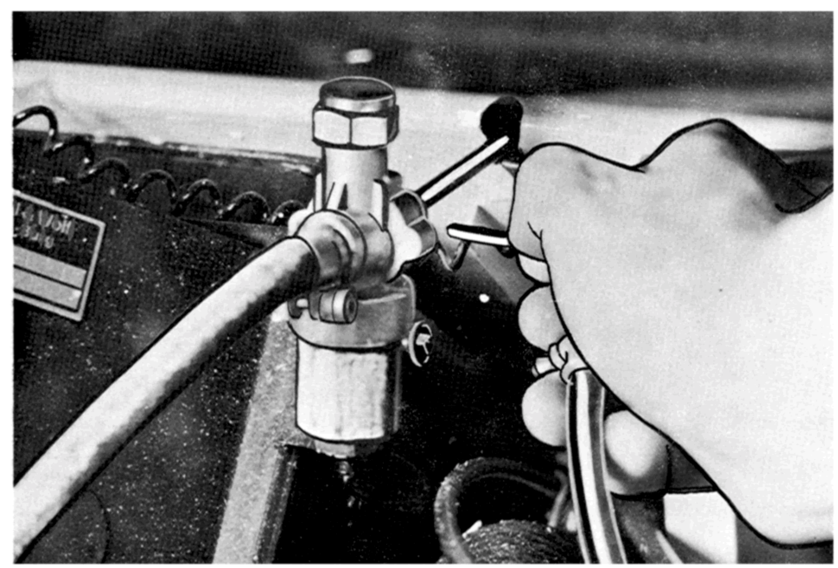

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FUEL SYSTEM

DESCRIPTION

The fuel is fed to the carburettor by means of a diaphragm type pump. The fuel tank is located in the trunk. The filler neck incorporates an air vent to the exterior of the trunk lid. Also mounted on the fuel tank is the fuel gauge unit. Tank capacity 12.5 U.S. gallons. Fuel shut off tap is located at the bottom of the tank and an operating lever runs from the tap through the firewall to the interior of the car, thus enabling the driver to operate the tap from the driver's seat, (Fig. 1a = open, Fig. 1b = closed).

It is advisable to place the handle upwards in the open position (by transposing the splint in the handle at the tap). Such a position excludes the possibility of the driver pressing against the handle and causing a fuel leak in the fuel tap through deformation of the gasket (See Fig. 4).

CLEANING THE FUEL FILTER

A filter is located below the fuel tap to trap all dirt and water in the fuel.

The filter gauge must be cleaned every 5000 miles.

Close fuel tap (operating lever in horizontal position).

Dismantle filter, (Fig. 2) unscrew gauge (Fig. 3).

Empty filter and wash together with fuel gauze in clean gasoline and blowout with compressed air.

Before reassembling, check if any of the fuel tap openings are dirty.

For this purpose, place a container under the fuel tap and open the tap (vertical position). If the flow is clear, close tap.

Ensure that fuel does not leak into bilge during any servicing of fuel pump, tank, filter, etc.

It is also recommendet that the threads be covered with graphite grease to avoid damage or corrosion.

All damaged gaskets must be replaced.

REMOVAL OF THE FUEL TAP

Close fuel tap.

Loosen pipe clip on the fuel pipe.

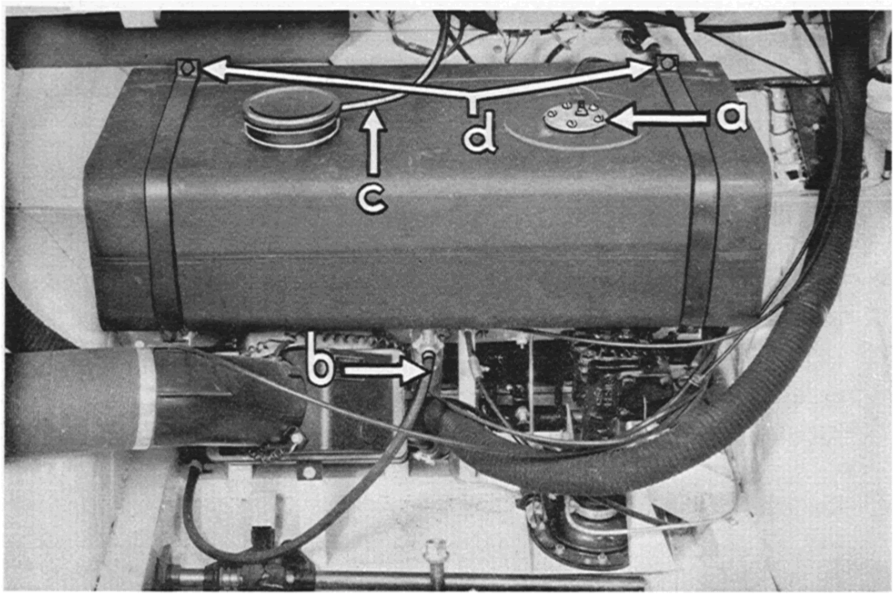
Remove fuel pipe.

Drain gasoline into a clean container.

Remove split-pin of fuel tap handle (Fig. 4).

Put out linkage.

Dismantle nut of fuel tap (left and right hand thread) and remove fuel tap and gasket and clean.



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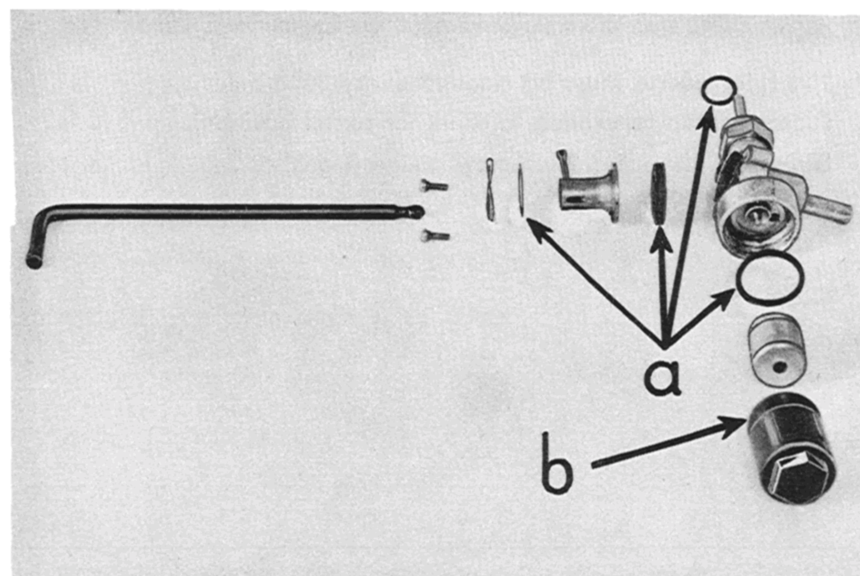

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The fuel tap is taken apart as follows:

Dismantle water separator.

Remove screw cap with screen gauze.

Remove gasket of filter.

Unscrew two screws of the pivot pin.

Remove gaskets and pivot pin.

Check parts for wear and damage.

If, in addition to the gaskets, other damaged parts are found, the entire fuel tap must be replaced.

Assemble in reverse order.

Fig.2 shows dismantled fuel tap.

NOTE: At each assembly replace all gaskets and sealing rings of the fuel tap (Fig. 2a). The thread of the filter must be greased with graphite grease, to avoid corrosion when screwed in (Fig. 2 b).
Prior to assembling, check fuel pipe and replace it, if necessary.

After assembly and remounting, open fuel tap and test for leaks.

This check must be made very carefully, as gasoline must not flow into the bilge under any circumstances.

If gasoline should seep into the bilge during draining, remove it by opening the bilge drain plug and rinse out with water.

GAUGE UNIT

To dismantle the gauge unit, loosen five securing screws and disconnect electrical connection (Fig. 1a).

It is not recommended that the gauge unit be repaired.

If found defective, replace the gauge unit. Clean the sealing areas prior to remounting. The gasket for the gauge unit must be fitted with a sealer compound.

DISMANTLING THE FUEL TANK

Close fuel tap (horizontal position of lever).

Remove split pin from handle.

Remove pipe clip from fuel tap and pull off fuel pipe (Fig. 1 b).
Disconnect the electrical wires.

Remove vent ipe from filler neck (Fig. 1 c).

Remove both bracket strap retainer bolts (Fig.1 d).

Put bracket straps aside and lift out fuel tank.

Assemble in reverse order. If felt strips under the bracket straps are found defective, they must be replaced.

REPLACING OF FUEL PIPE

The following operations are required for replacing the fuel pipe:

Dismantle front and back seats, rubber mats and floor pan coverings. Open trunk and engine covers.

Dismantle trim panel of trunk.

Close fuel tap.

Open pipe clip at fuel tap.

Remove fuel pipe.

Open clip of fuel pipe at fuel pump and remove fuel pipe.

When re-assembling, place pipe in original position without sharp bends.

Replace pipe clips.

TROUBLES IN FUEL SYSTEM

If the fuel does not reach the carburettor, check the following:

Empty fuel tank.

Loose hexagon screw in fuel pump cover or faulty gaskets in the filter cover head of the fuel pump.

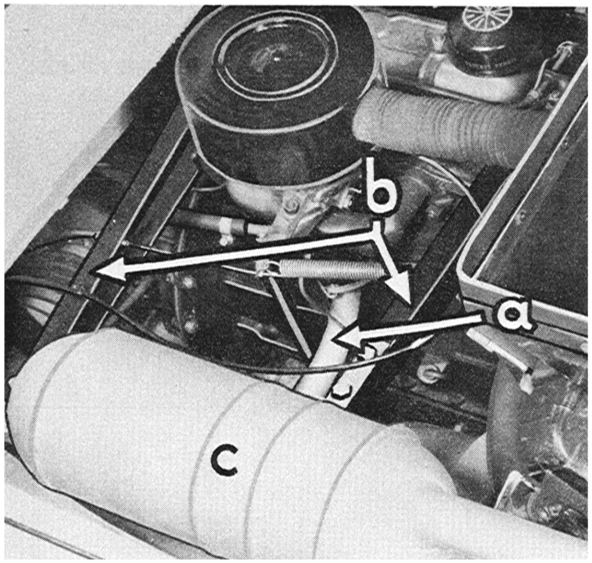
Defective fuel pump valves.

Leaking screw connections and pipes.

Excessively bent fuel pipe.

Blocked filter in fuel tap.

Dirty filter gauze in the filter cover head of the fuel pump.



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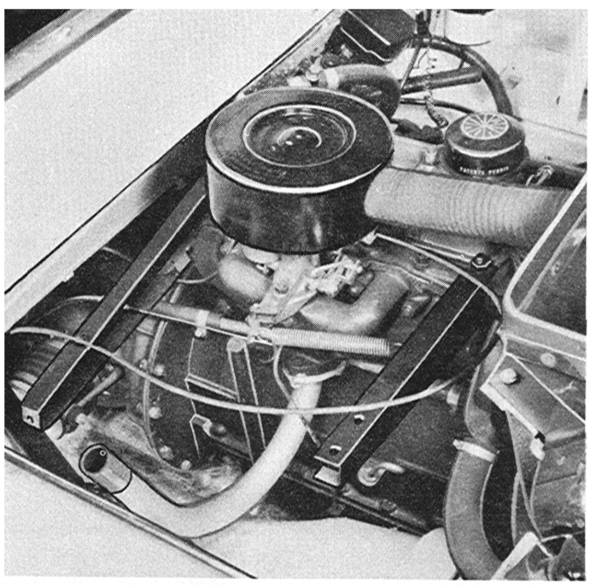
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3

EXHAUST SYSTEM

The exhaust system consists of the exhaust pipe with clip (Fig. 1 a), two mounting brackets (Fig. 1 b). The exhaust silencer (muffler) (Fig. 1 c) and mounting bolts. The exhaust pipe end piece has affixed to it a plate which together with the gasket covers the opening through the rear wall of the engine compartment. This end piece connects with the tail pipe of the exhaust silencer (muffler).

REMOVAL OF THE MUFFLER:

1. Unscrew the bolt holding the exhaust pipe end piece and remove end piece.
2. Unscrew mounting bolts from front and rear mounting brackets as well as from the clip securing the exhaust pipe to the muffler.
3. Remove the muffler.

Before reinstalling or replacing, check the mounting brackets for cracks or looseness. The exhaust pipe is secured to the manifold with three nuts under the flange (Fig. 2).

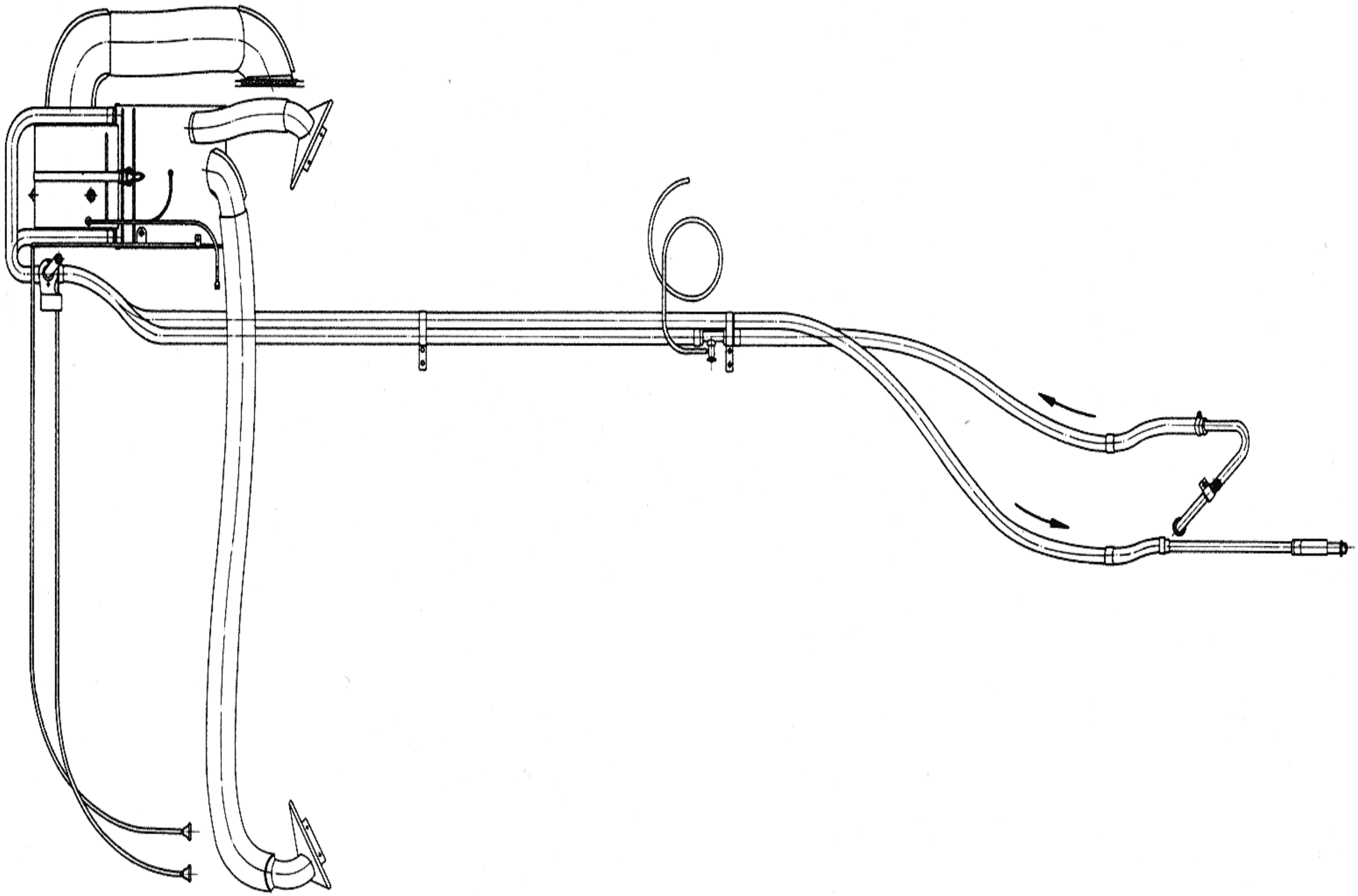
It is desirable to use a new gasket (manifold) when replacing the exhaust pipe and care must be taken to avoid any stress when reassembling.

TO REASSEMBLE EXHAUST SYSTEM:

1. Connect the exhaust pipe to the exhaust manifold using the new gasket and thermac nuts 5/16" 24 pitch.
2. Slide clip over the exhaust pipe and place muffler in position.
3. Fasten the mounting bolts on the mounting brackets and on the clip, making sure that the muffler is so placed that the tail pipe is in the exact center of the opening in the rear wall of the engine compartment.

   If necessary to adjust the position of the tail pipe, use washers between the mounting brackets and the muffler supports (Fig. 3).
4. Tighten all bolts.
5. Check the rubber gasket and ring fitting over the opening.
6. Place the exhaust pipe end piece through the hole in the rear wall of the engine compartment fitting it over the tail pipe so that the round plate is flush with the gasket and tighten the holding screw.

NOTE: Beginning with serial no. 101 670 for red and green vehicles and serial no. 101 250 white and blue vehicles, a new exhaust system was installed at the factory. For all vehicles having serial nos. lower than the above, the muffler and exhaust pipe of the new exhaust system should be installed as one unit for replacement.



COOLING AND HEATING SYSTEM

COOLING

NOTE: The following parts and aggregates of the cooling, which according to the maintenance manual are comprised in the delivery bulk of the engine, are specified in group 1, pp. 60-69:

Dimensions were based on English measurements (inch).

Feelers and water-temperature gauge are explained in group 10 (electrical installation).

All measurements of parts pertaining to group 9 are based on metric measurements.

DESCRIPTION

Engine cooling results from water circulation by means of a water pump. The thermostat opens at (72° C) 162° F water temperature. The water pump is a centrifugal vane wheel pump which is operated by the V-belt from the crankshaft pulley. The six-bladed fan mounted on the water pump pulley absorbs the outside air through the inlet port of the engine cover, the deck lid, the cooler and the air intake housing.

The heated air in the engine compartment escapes through the exit slots of the engine cover into the open air.

COOLER

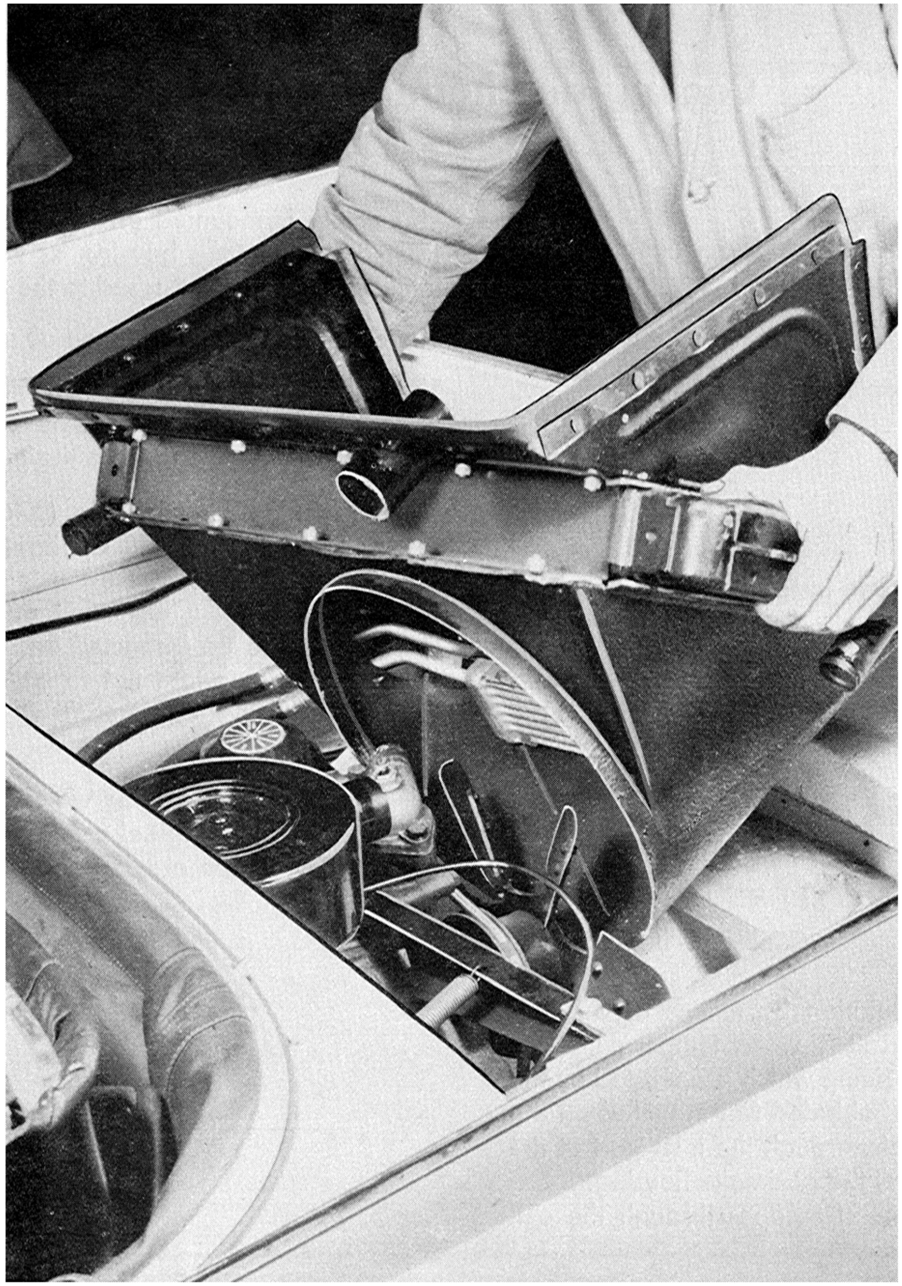
The cooler is mounted on two brackets by four anti-vibration buffers. Inlet and air intake housing as well as the oil cooler located in the intake housing are attached to the cooler by screws.

The copper cooler is designed as a gilled-tube cooler.

Through the relief pressure valve in the radiator cap a closed cooling water circulation is attained. Thereby the boiling point of the cooling water is raised according to the excess pressure in the circulation.

Upon reaching of 7 lb/sq. in. (0.46 atmospheric excess pressure), corresponding to 230° F (110° C), the relief pressure valve in the cooler cap opens. This extreme operating temperature should not be exceeded. In the event that a deviation of the established data is noted, the thermostat is to be inspected and the radiator cap is to be replaced. It is equally important not to operate the cold engine in excess. The normal operating temperature is indicated by the water-temperature gauge.

For replacement of cooling water hoses, heating hoses, thermostat and radiator cap only original spare parts should be used! Original cooling and heating hoses are impervious as well as oil and sea water resistant.



Radiator hose diameter (inside)	= 1 1/4"
Heater hose diameter (inside)	= 5/8"

The cooling and heating system contains approximately 7 qts.

For leak tests of the radiator in the water bath the test pressure may not exceed 1 atmospheric excess pressure.

The draining cock of the cooling and heating system is located under the rubber mat on the right-hand side behind the passenger seat. It is accessible upon opening of the cover in the floor.

The venting screws on the heater unit as well as on the intertube above the rocker cover are opened in the process of draining.

After filling of the system and after the engine reaches operation temperature open the venting screws to remove the air in the cooling unit.

ANTIFREEZE SOLUTION

If the outside temperature approaches the freezing point, an antifreeze solution is to be added to the water in the cooling unit. It is recommended to use only quality antifreeze compounds.

REMOVAL AND INSTALLATION OF THE RADIATOR

The removal of the radiator should be carried out as follows: Disconnect the electric cable at the plug connector and remove engine cover (deck lid) (Page 1/12 - Fig. 1).

Drain water (Page 1/12 - Fig. 2).

Rubber hose clips on the radiator are to be detached and the hoses to be pulled from the connecting pipe. Return hose on the thermostat elbow is to be detached and removed.

Oil cooler hoses on the adaptor are to be detached (Page 1/12 Fig. 3).

Remove the vacuum hose of the carburettor.

Remove the radiator four securing screws.

Lift radiator out. Proceed with great care to avoid deformation of the fan blades (Fig.1).

The rubber profiles are attached by rivets to the air intake housing and the inlet cone.

The installation of the radiator should proceed in reverse order.

The screws attaching the standard hose clips should not be tightened too firmly, since the screws otherwise bend and the clips thereby become useless.

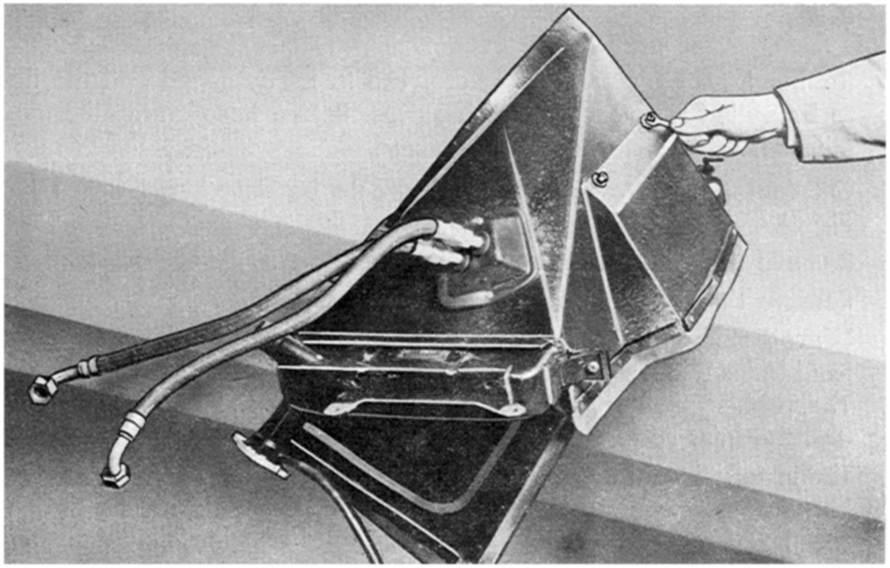
Defective engine and transmission mountings may cause the fan blades to strike the inlet cone. The subsequent noise is particularly noticeable upon starting of the car or when cornering.

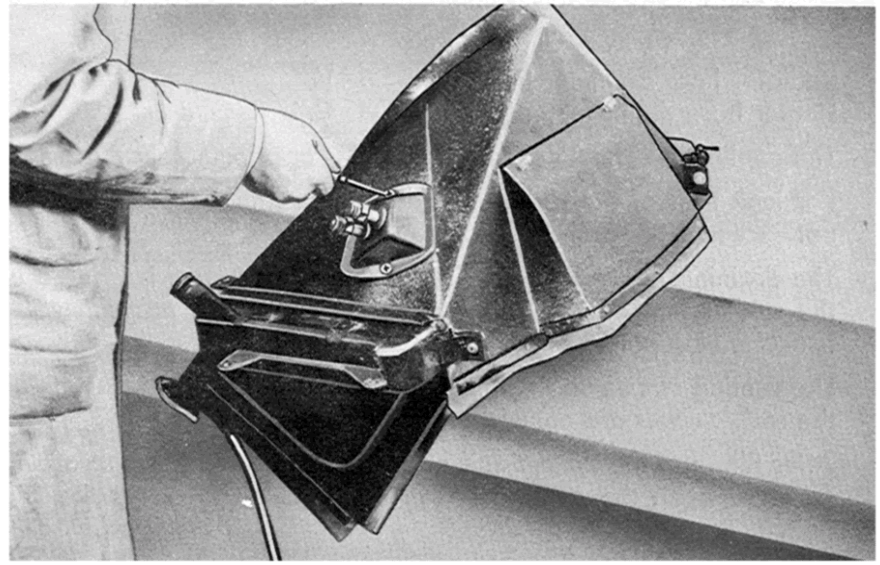
In this case the defective metal silent blocks are to be replaced and the free gap between fan blades and inlet cone must be centered up.

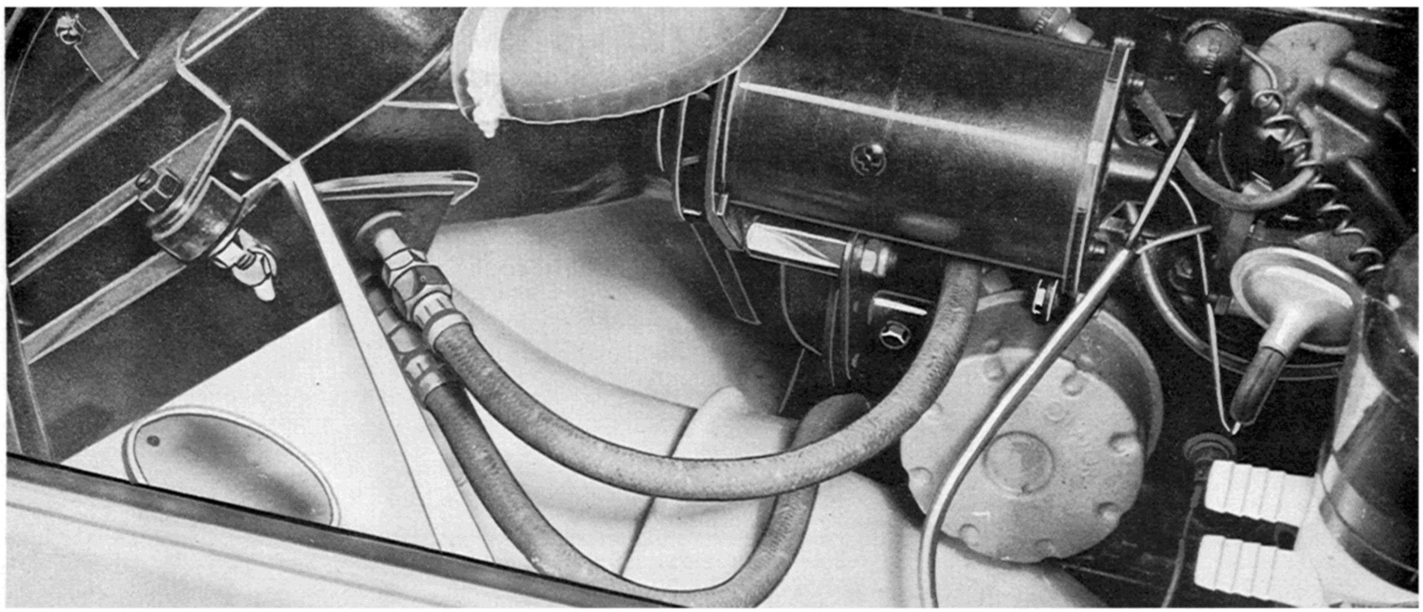
OIL COOLER

DESCRIPTION

The completely encased structure of the engine inside the craft allows no natural cooling of the oil sump and subsequently the engine oil.







For this reason an oil cooler had to be provided in the cooling air current of the water cooler. The temperature of the engine oil is regulated by a pressure valve in the adaptor which, depending upon the viscosity of the oil, releases the circulation over the oil cooler or prevents circulation of cold, viscous oil. The engine oil thereby quickly reaches its operating temperature. (Page 1/46 - Fig. 1 & 2).

The oil cooler does not require attendance. Inspection from time to time however should assure that no impurities collected on the outside of the cooler net. In this case the cooler must be demounted in order to remove the impurities; ignoring of this instruction results in power loss of the unit.

REMOVAL AND INSTALLATION OF THE OIL COOLER

The removal of the oil cooler is carried out as follows: Drain cooling water.

Remove radiator (see Page 9/5).

Remove oil cooler hoses at the oil cooler connection (do not bend pipe connections!).

Unscrew mounting screws (Fig. 1).

Take out 2 rubber sleeves and unscrew cover plate (Fig. 2).

Lift out oil cooler.

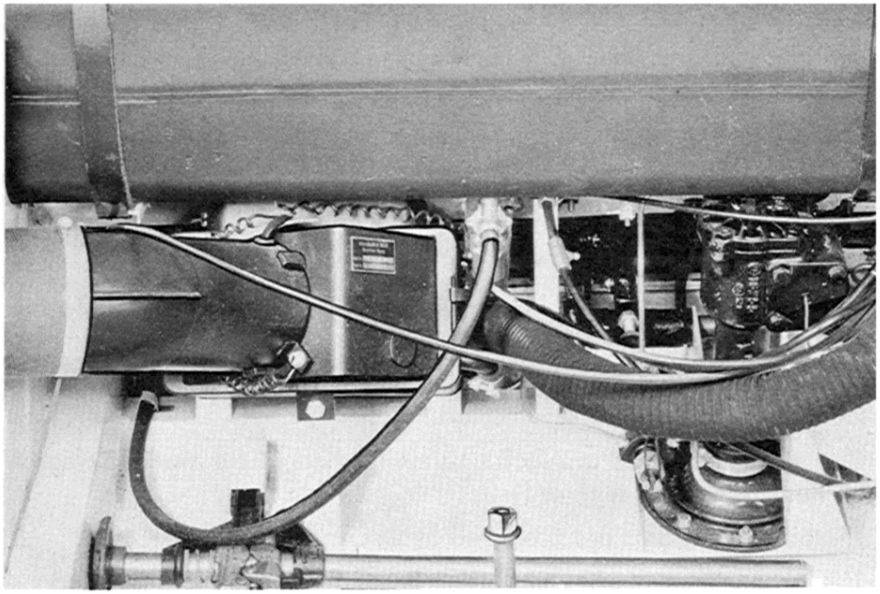
The installation proceeds in reverse order, but taking note of the following:

The rubber connection as well as the rubber sleeves are to be inspected for defects and if necessary replaced.

The oil cooler hoses are to be carefully checked for wear. Defective oil hoses are to be replaced!

The oil cooler hoses are protected by PVC insulation hoses.

The connections of the oil cooler hoses must not be inter-changed during mounting (Fig. 3).



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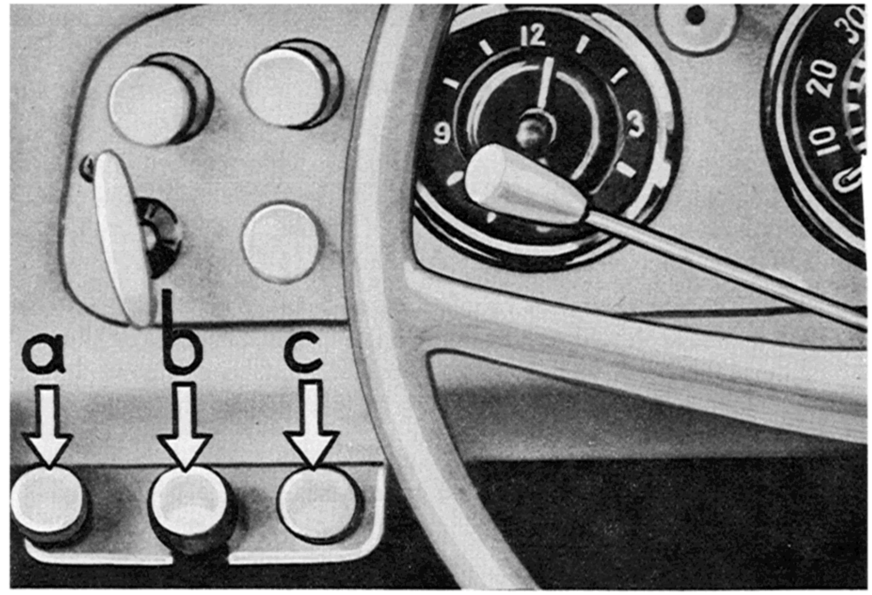

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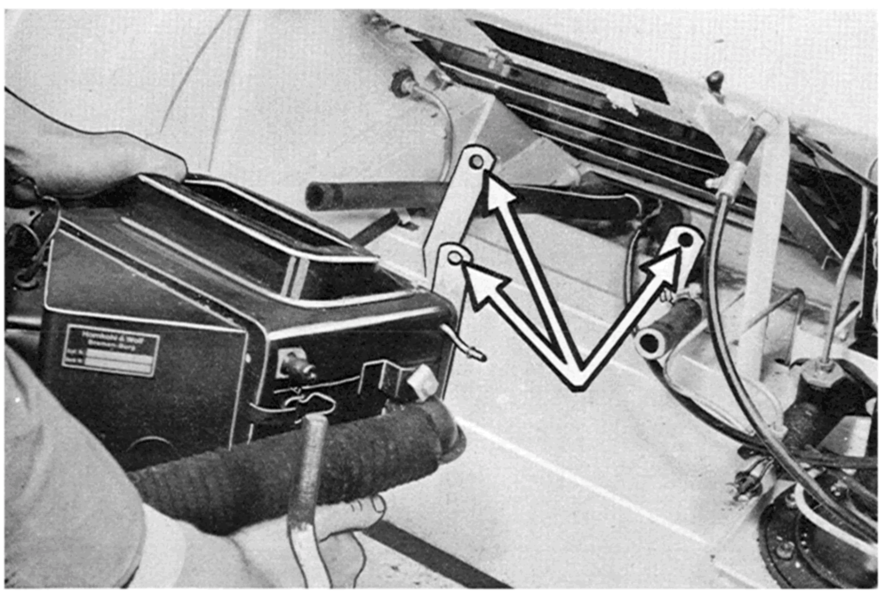

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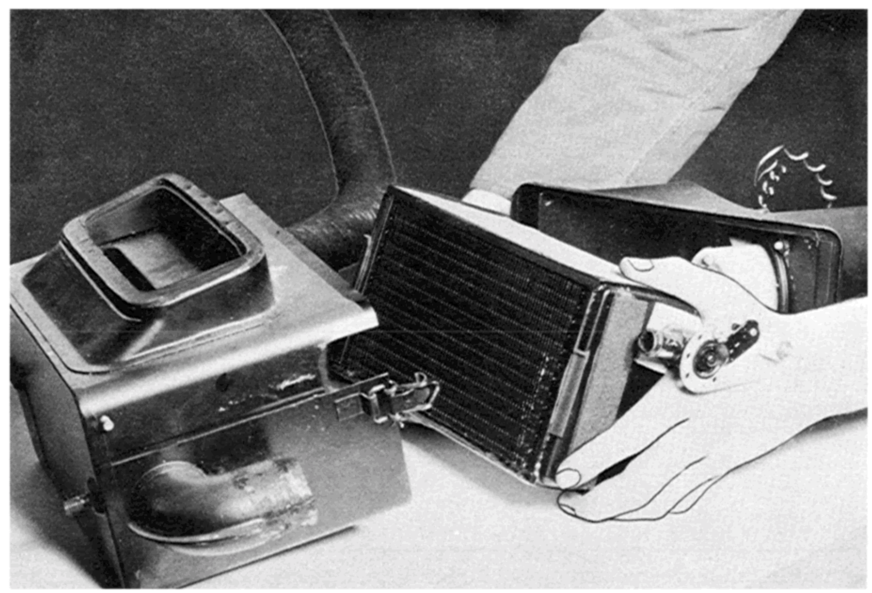


4

HEATER

DESCRIPTION

It is a hot water heater with an electrically driven fan. The heating system consists of the heater unit (Fig. 1) in which the radiator and the fan motor are arranged, the control cables for the heater, the hot air hoses with the defroster outlets, left and right, the fresh air hose and air intake with air intake screen, as well as the water hoses with air vent valve and drain cock arranged in the bilge.

The heated water is fed into the radiator above the cylinder head via the water hose and is withdrawn by the water pump through the return water hose.

By operating the Bowden cable for the heater cock, the water circulation of the heater is released. (Heater cock arranged at heater in the inlet hose.) The air drawn in by the fan from the passenger compartment through the air intake is carried through the radiator and can be fed into the interior of the car, if required, by operating the bowden cable for the heater control. The air is then fed through the defroster outlets or through the floor pan ducts into the interior.

OPERATION

The operating buttons for the heater are arranged below the instrument panel, on the left hand side (Fig. 2).

They consist of push-pull cable for the heater control (Fig. 2 a), switch for the heater fan (Fig. 2 b), push-pull Bowden cable for the heater control cock (Fig. 2 c).

To switch on the heater for winter use, pullout the Bowden cable (Fig. 2 c), the switch (Fig. 2 b) and, as required, the air flow control of the defroster outlet or of the floor pan duct of the Bowden cable (Fig.2a).

In order to use the heater fan for cool air circulation in the vehicle during summer use, the switch (Fig. 2 b) and the Bowden cable (Fig. 20), are operated as required.

DISMANTLING AND ASSEMBLING THE COMPLETE HEATER

Dismantle and remove the fuel tank. (See page 8/5.)

Dismantle the trunk floor and the spare wheel.

Drain radiator. (See page 1/12, Fig. 2).

Loosen one front and the two rear retaining screws with a short, curved ring spanner.

Dismantle the clips of water hose at the heater and remove.

Loosen the hot air hoses at the intake and remove.

Dismantle the Bowden cables for the heater control and heater control cock at the heater.

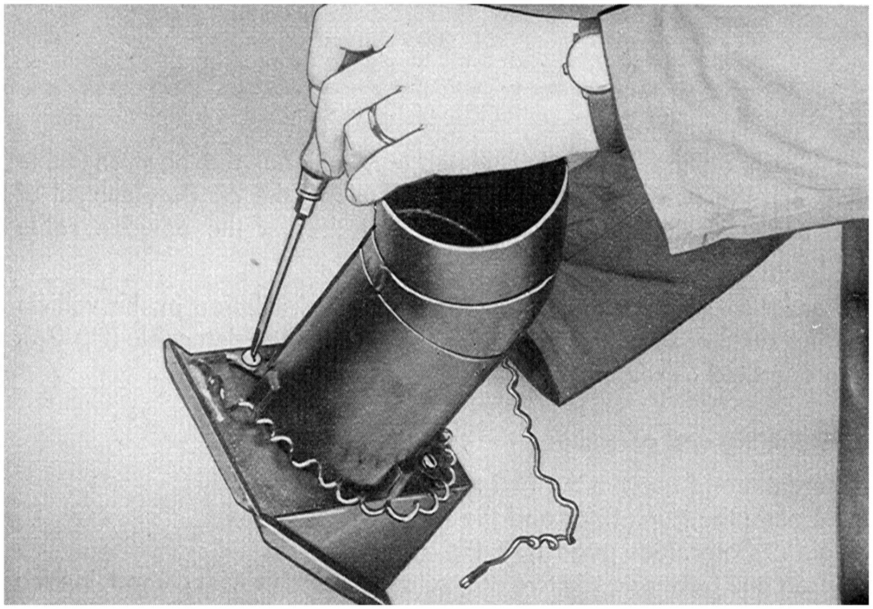
Loosen the cable of the fan motor at the cable sleeve.

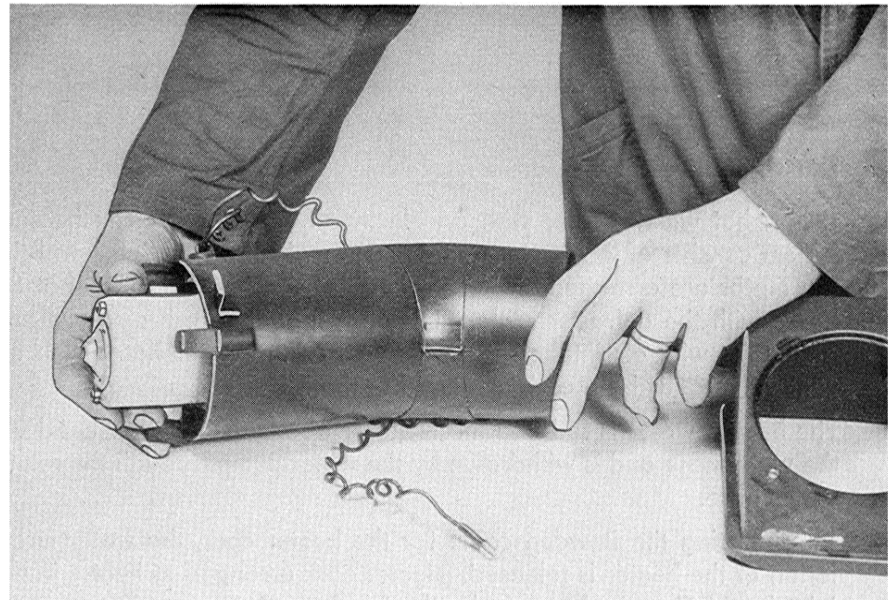
Remove air intake hose.

Remove heater (Fig. 3).

DISMANTLING THE HEATER

To disassemble the heater, loosen the fan housing retaining brackets. After removal of the fan housing, the radiator is pulled out of the heater body (Fig. 4).


1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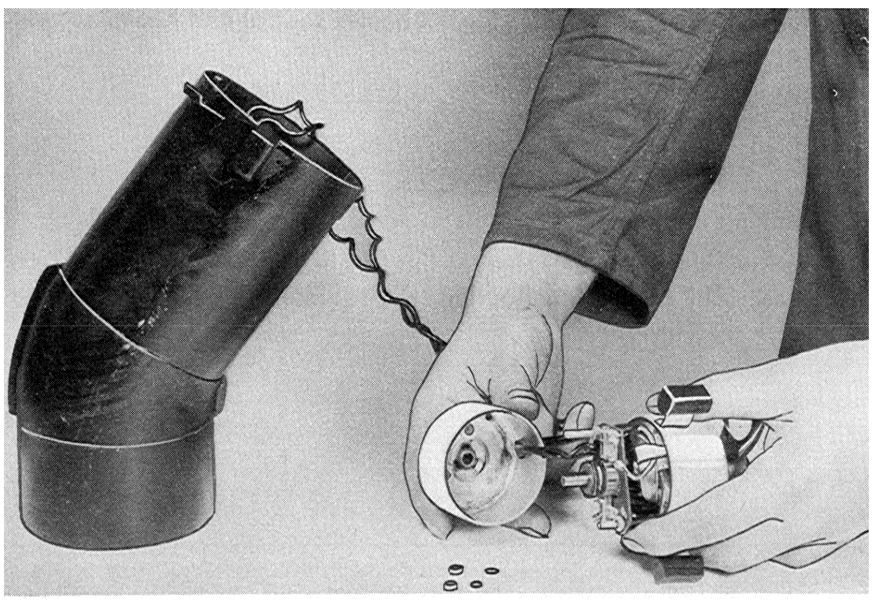
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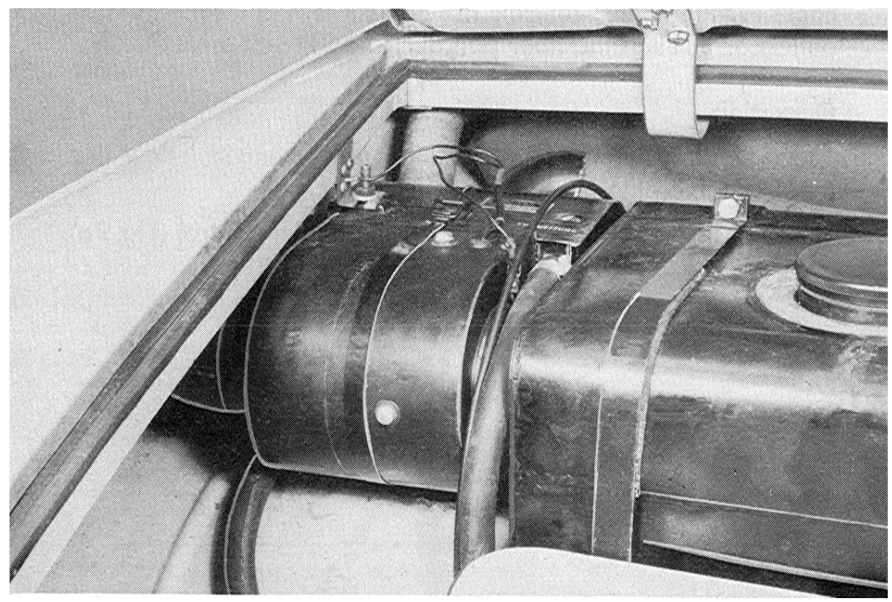

4

Assembly is effected in reverse order.

When assembling take care that the rubber shims are properly placed, so that no chafing spots occur on the radiator.

DISMANTLING THE HEATER RADIATOR

To dismantle the radiator it is not necessary to disassemble the complete heater unit.

The following dismantling operations are required:

Dismantle trunk floor and spare tire.

Remove fuel tank.

Drain radiator.

Remove air intake hose and loosen holding brackets of the fan housing.

Remove fan housing.

Loosen hose clips of the water hoses, remove hoses.

Dismantle bowden cable at the cock and pullout the radiator from the housing.

DISMANTLING OF THE FAN MOTOR

If, in case of a defect, only the fan motor must be removed, it is not necessary to dismantle the complete heater.

Only the following dismantling operations are required:

Remove trunk floor and spare tire.

Loosen holding bracket at fan housing.

Disconnect current supplying cable at the plug-in connection.

Remove hose from air intake and take out fan housing.

Loosen both holding screws of the air intake at the fan housing. (The negative cable of the fan motor is clamped on under one of the holding screws.) (Fig. 1.)

Pullout fan motor with rubber base out of the air intake (Fig. 2).

Assembly is effected in reverse order.

DISMANTLING THE FAN MOTOR

To reach the commutator and the carbon brushes the two nuts at the opposite side of the fan wheel are loosened and the two halves of the housing are separated. When removing the half of the housing, push the current supply cable through the cable insulator cover (Fig. 2).

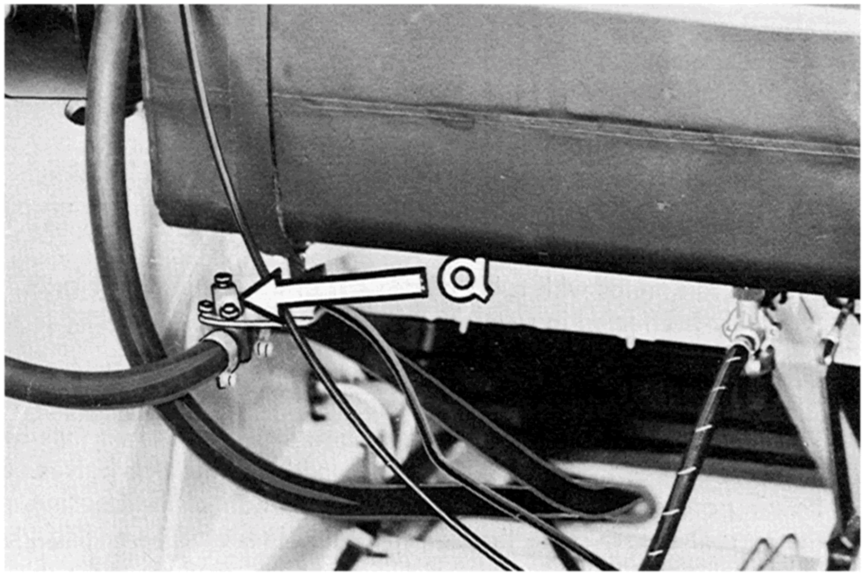
When a repair of the fan motor is needed, it is limited to the cleaning of the commutator and to the replacement of the carbon brushes.

In case of any further defects, the entire motor is to be replaced. The switch (page 9/8, fig. 2 b) closes the circuit of the fan motor.

Data of the Heater:		2100 kcal.
	Air output	108 m^3/hr.
	Power input of the motor	27 W.

HEATER (VERSION BEGINNING WITH SERIAL NO. 103 001)

After serial no. 103 001, the factory has installed a new heating unit. The heater is mounted in the trunk, at the right hand side, between the fuel tank and the side wall (Fig. 4).



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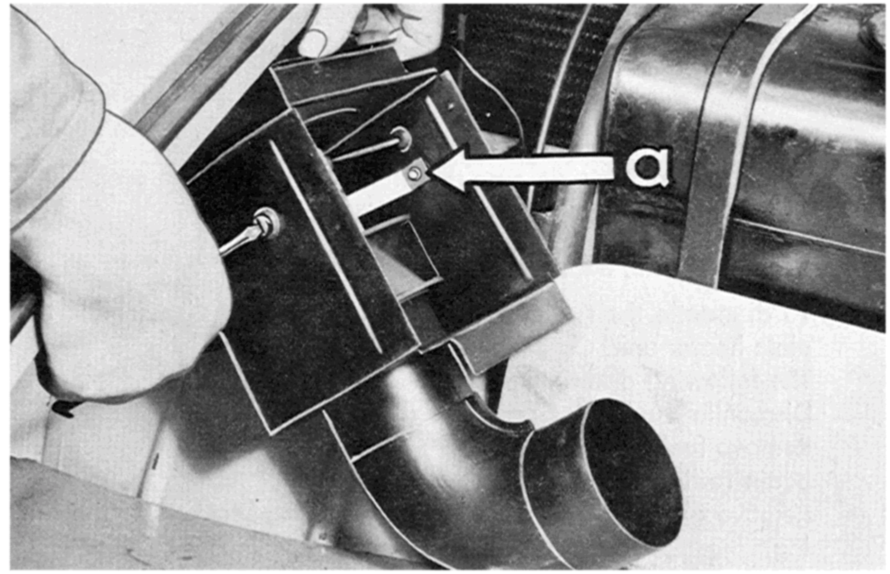

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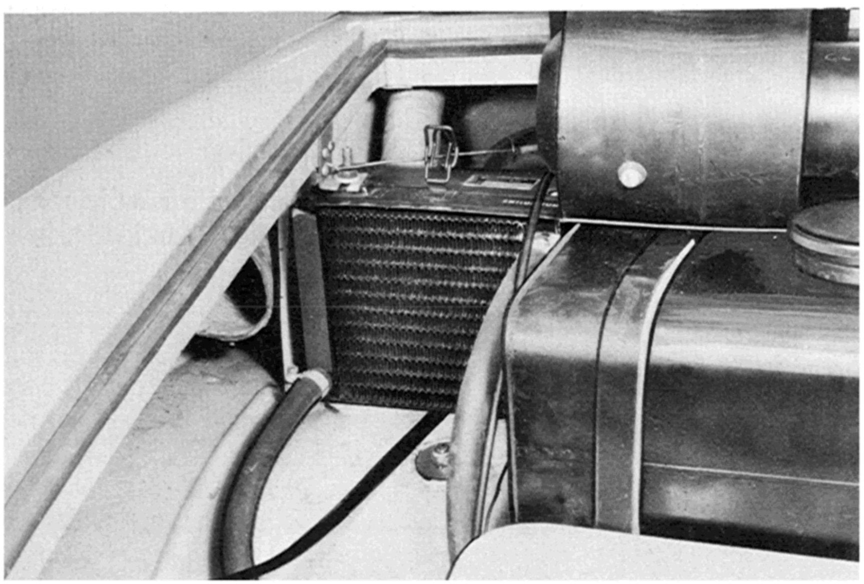

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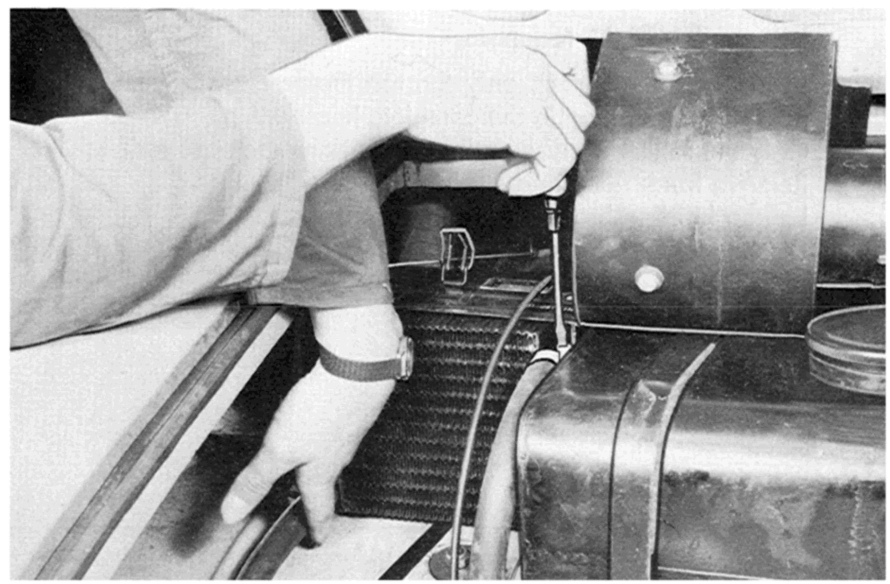


4

The following changes were incorporated:

1. Heater unit complete.
2. Heater—water hoses.
3. Drain cock.
4. Air hose.
5. Air intake.
6. Defroster outlets.
7. Warm air hoses.
8. Bowden cables for heater control.
9. Floor pan duct.
10. Screen for air intake.
11. Free flow cock with Bowden cable securing ring is mounted on the fuel tank-bracket (Fig. 1a).

DISMANTLING AND ASSEMBLING THE COMPLETE HEATER UNIT

After serial no. 103 001.

Drain water.

Disconnect electrical cable connections.

Remove cooling baffle in passenger compartment.

Loosen both holding screws securing heater unit.

Remove securing screws at bracket (right front side), water and air hoses as well as the Bowden cables.

Pullout heater towards front.

Assembly is in the reverse order.

REMOVING THE FAN MOTOR (FIG. 2) (AFTER SERIAL NO. 103 001)

The following operations are required for removing the fan motor: Loosen holding clip and place to the forward position.

Disconnect electrical connections.

Remove air intake hose.

Pullout fan housing toward front.

The fan motor is mounted on three supports in the housing. Between the housing and the supports, rubber buffers are inserted (Fig. 2 a). Repairs to the fan motor: See description on page 9/11 Removing of the heater radiator is the same procedure as disassembling the fan housing as described in the preceding section (Fig 3).

Drain water.

Remove heater hoses (Fig. 4).

Pull out radiator towards front.

After reassembling, it should be checked that the housing passes freely within the prescribed 3/16" of the shock-absorber leg. Otherwise, this distance can be achieved through adjustment to the bracket by an addition of distance washers.

DATA OF THE HEATER:

Heater performance	3160 kcal.
Air output	200 m^3/hr.
Power input of the motor	47 W.

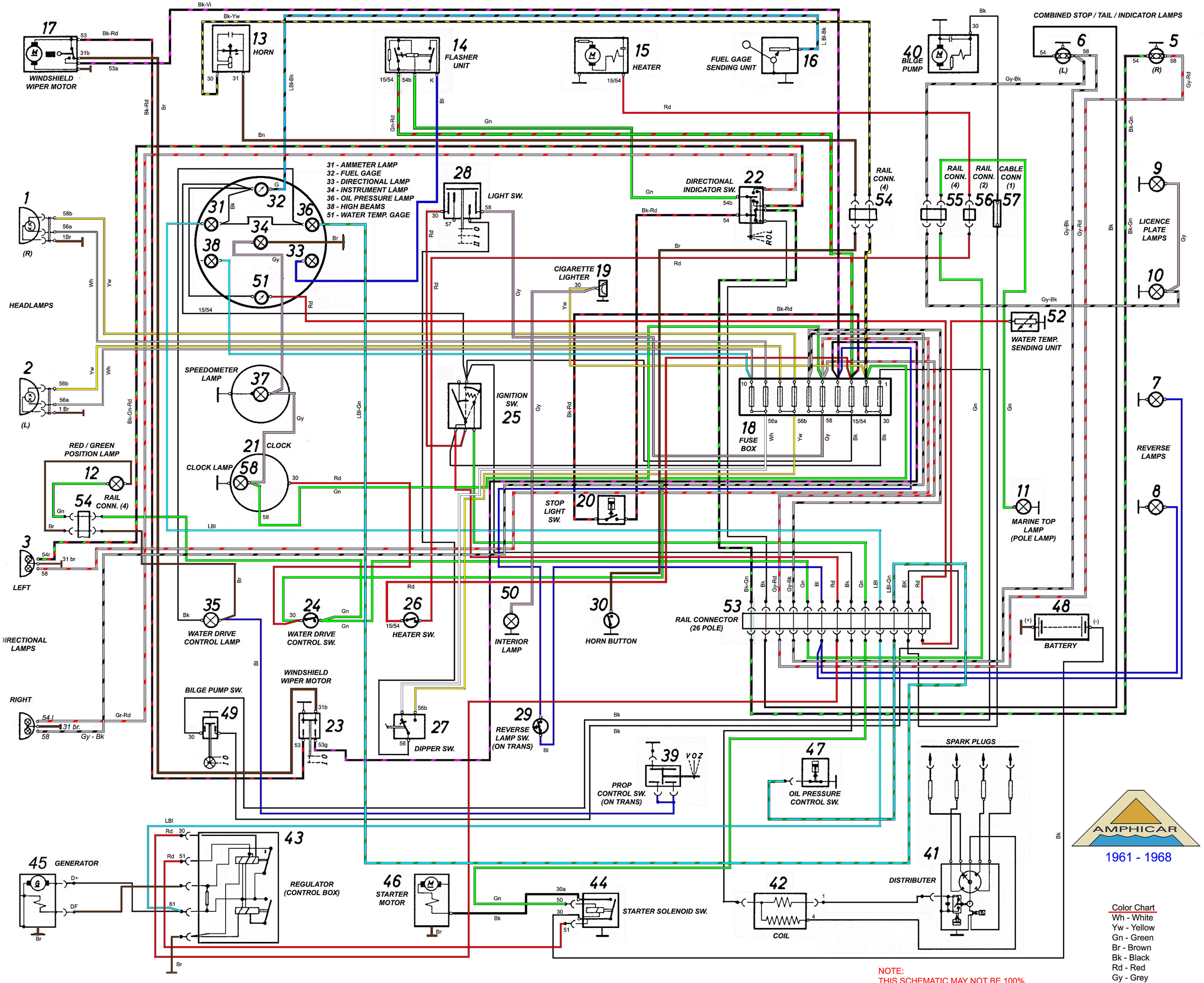
REPLACING THE WATER HOSES

To dismantle the hoses arranged in the bilge, it is necessary to remove the seats., seat base, rubber mats and floor.

It is again stressed that when replacing water hoses only original spare parts should be used.

These are resistant to light cracks and also to oil and salt water.

The draining and filling of water as well as the venting of the heater system is described in the section headed "Radiator".

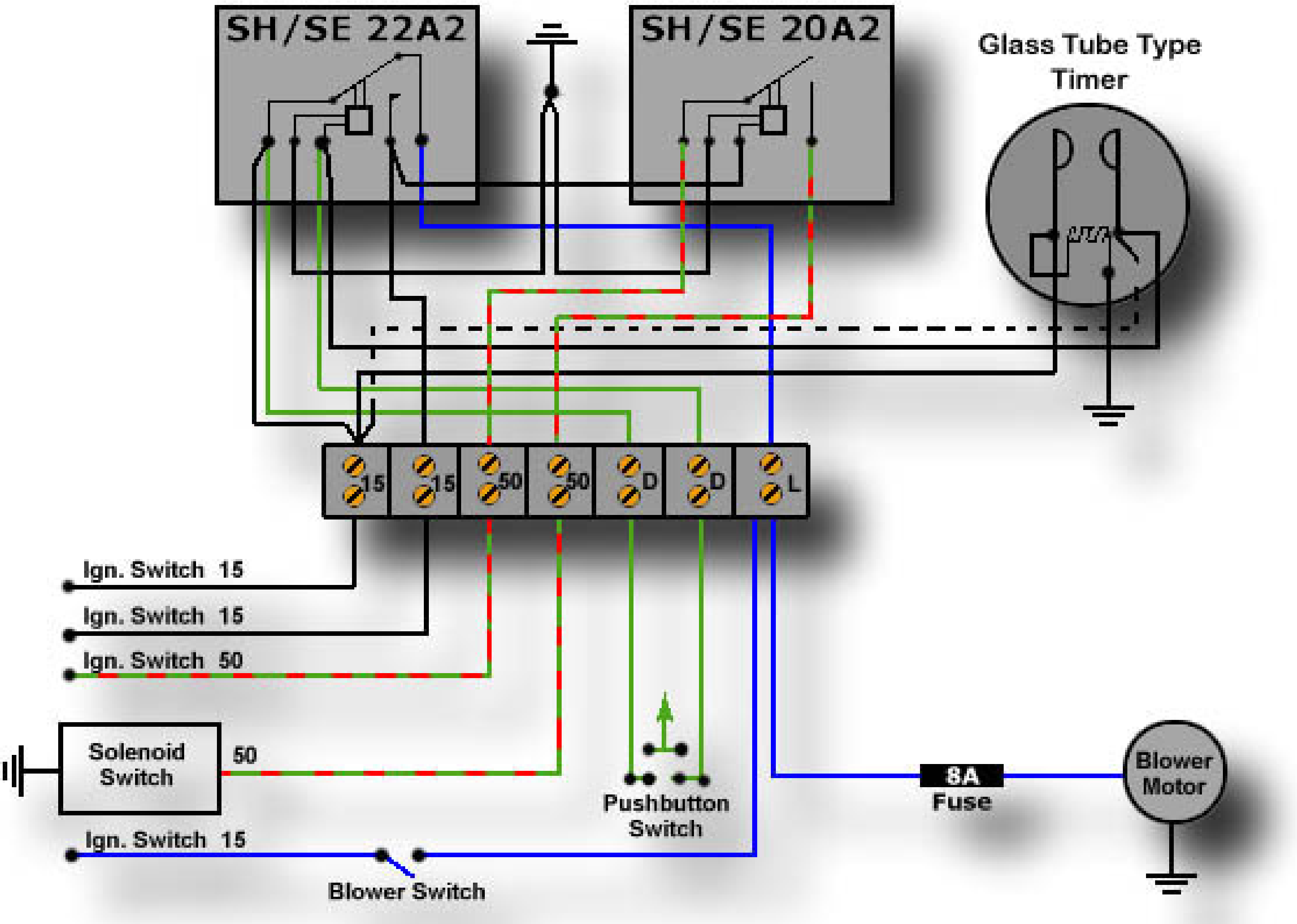


Color Chart
Wh - White
Yw - Yellow
Gn - Green
Br - Brown
Bk - Black
Rd - Red
Gy - Grey
LBl - Light Blue
Bl - Blue
Vi - Violet

NOTE:
THIS SCHEMATIC MAY NOT BE 100% CORRECT FOR ALL CARS. THERE ARE SLIGHT DIFFERENCES BETWEEN EARLY PRODUCTION AND LATE PRODUCTION CARS.

NOTE: POSITIVE GROUND

Bilge Blower Wiring Diagram



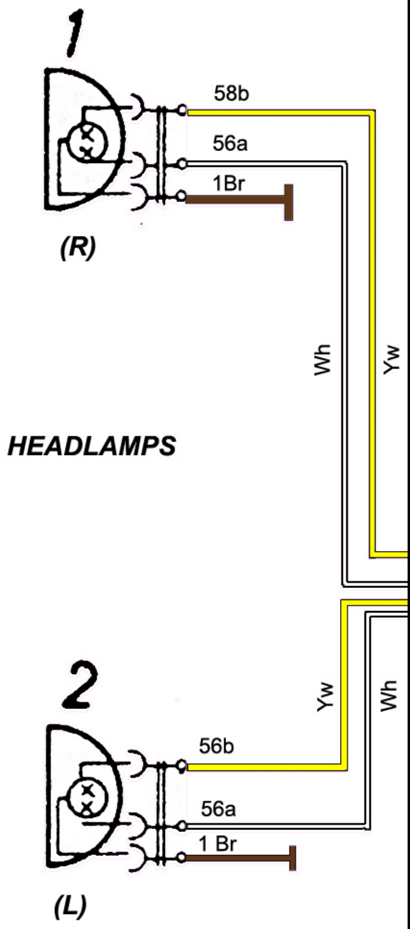
EXPLANATION OF WIRING DIAGRAM

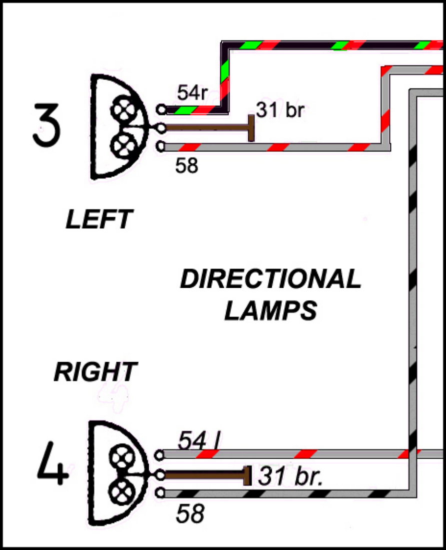
Positive cable to chassis

1. Headlamp right
2. Headlamp left
3. Direction indicator (front right)
4. Direction indicator (frong left)
5. Combined tail stop light and indicator (right)
6. Combined tail stop light and indicator (left)
7. Reversing light (right)
8. Reversing light (left)
9. License plate lamp (right)
10. License plate lamp (left)
11. Top light, Marine
12. Red-green position light, Marine
13. Horn
14. Flasher unit
15. Heater
16. Tank unit for fuel gauge
17. Windshield wiper motor
18. Fuse box
19. Cigarette lighter
20. Stop-light switch
21. Electric clock
22. Direction indicator switch
23. Windshield wiper motor switch
24. Water drive control switch
25. Ignition switch
26. Heater switch
27. dipper switch
28. Light switch
29. Reversing light switch
30. Horn button
31. Ammeter light
32. Fuel gauge
33. Direction indicator control light
34. Combined instrument light
35. Water drive control light
36. Oil pressure control light
37. Speedometer light
38. Main beam control light
39. Propeller control switch
40. Bilge pump
41. Distributor
42. Coil
43. Control box
44. Starter solenoid switch
45. generator
46. Starter motor
47. Oil pressure control switch
48. Battery
49. Bilge pump switch
50. Interior light
51. Water temperature unit
52. Water temperature gauge
53. Rail connector
54. Rail connector 4 pole
55. Rail connector 2 pole
56. Rail connector 1 pole
57. Cable connector 1 pole
58. Electric clock light

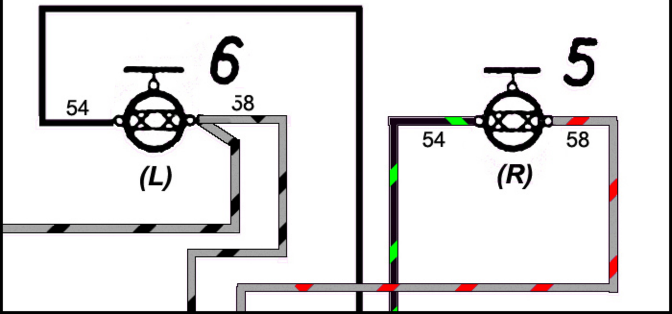
Color Chart

wss.	=	white
ge.	=	yellow
gn.	=	green
br.	=	brown
sw.	=	black
rt.	=	red
gr.	=	grey
hbl.	=	light blue
li.	=	purple

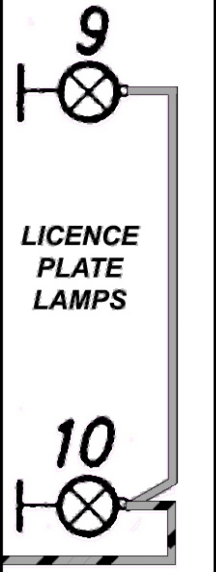

1
58b
56a
1Br
(R)
Wh
Yw
HEADLAMPS
Yw
Wh
2
56b
56a
1 Br
(L)

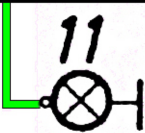

3
54r
31 br
58
LEFT
DIRECTIONAL
LAMPS
RIGHT
4
54 l
31 br.
58

COMBINED STOP / TAIL / INDICATOR LAMPS

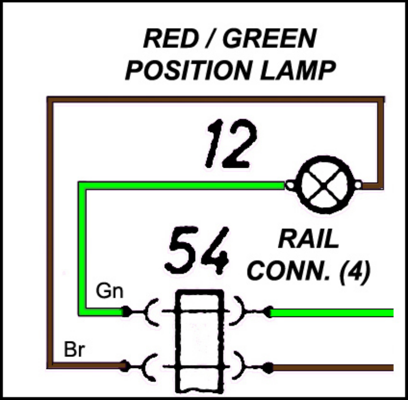


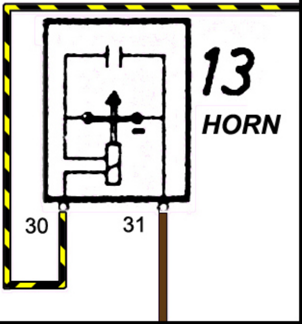

7
REVERSE
LAMPS
8


9
LICENCE
PLATE
LAMPS
10

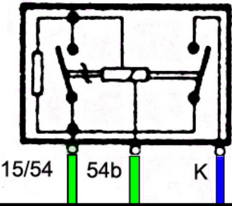


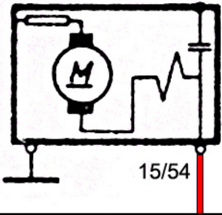
MARINE TOP LAMP (POLE LAMP)


RED / GREEN
POSITION LAMP
12
54
RAIL
CONN. (4)
Gn
Br


13
HORN
30
31

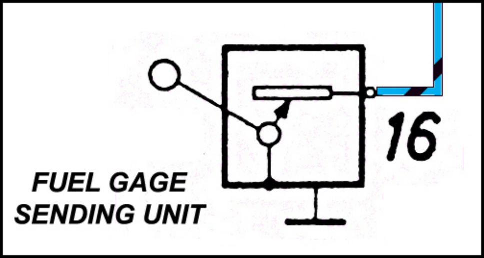
14 FLASHER UNIT

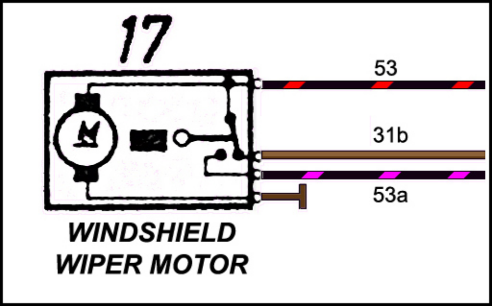


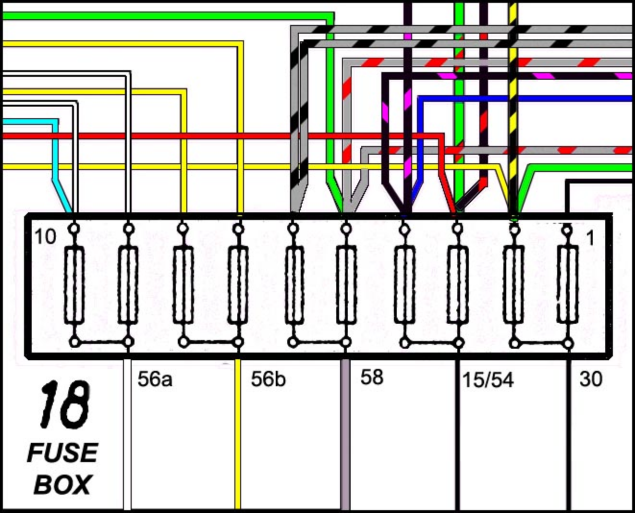


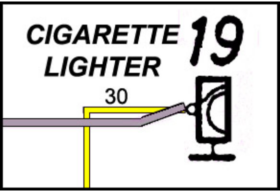
15

HEATER

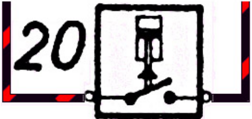

16
FUEL GAGE
SENDING UNIT

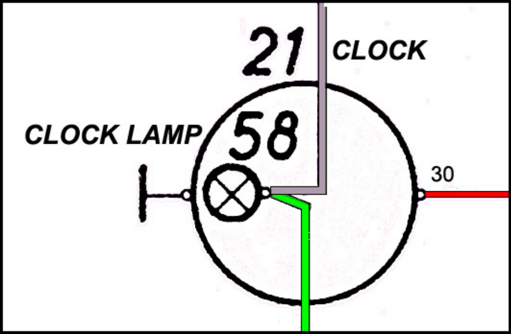

17
53
31b
53a
WINDSHIELD
WIPER MOTOR


10
1
56a
56b
58
15/54
30
18
FUSE
BOX

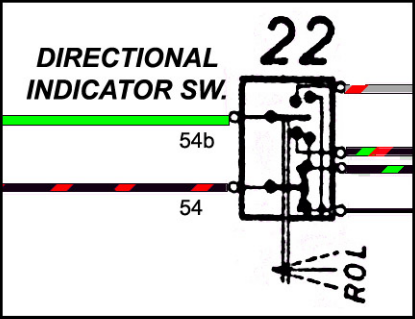

CIGARETTE
LIGHTER
19
30

STOP
LIGHT
SW.

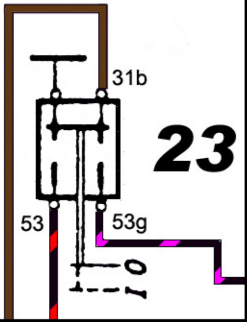


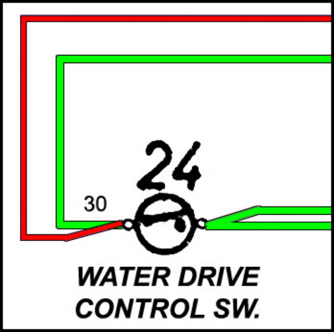


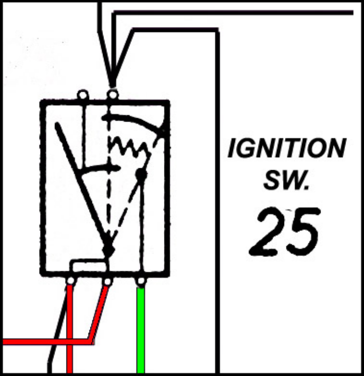
21
CLOCK
CLOCK LAMP
58
30

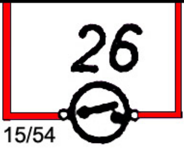

22
DIRECTIONAL
INDICATOR SW.
54b
54
ROL

WIPER MOTOR SW.

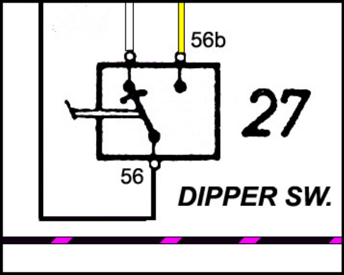



24
30
WATER DRIVE
CONTROL SW.

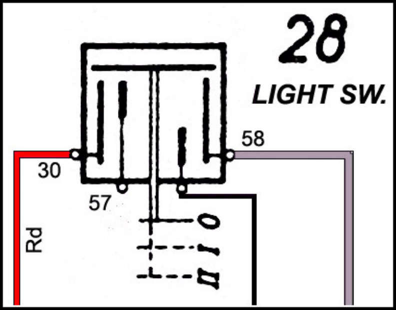

IGNITION
SW.
25



HEATER SW.



56b
27
56
DIPPER SW.

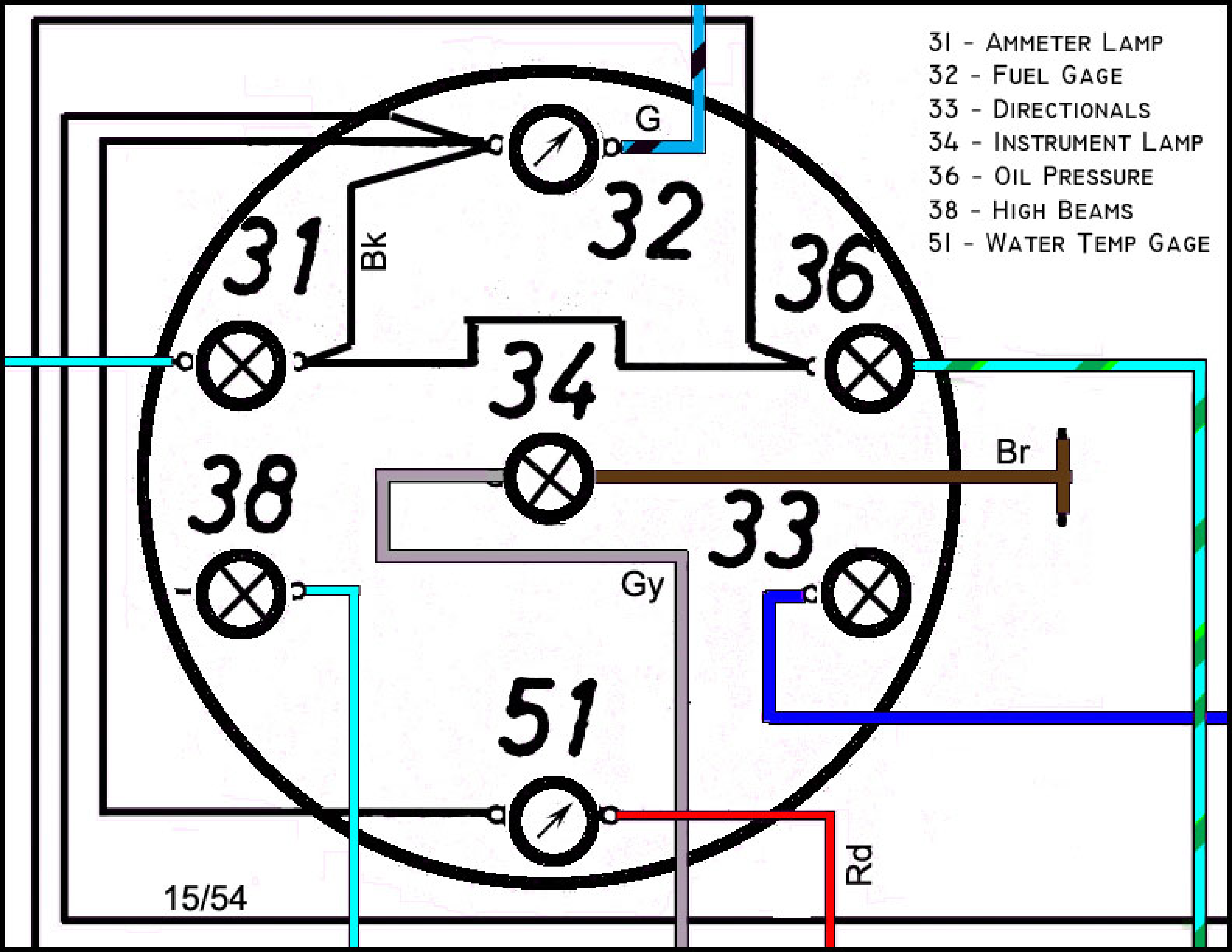

28
LIGHT SW.
58
30
57
Rd
0
I
II

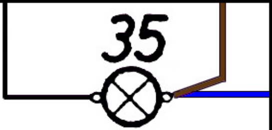
29

REVERSE LAMP SW. (ON TRANS)

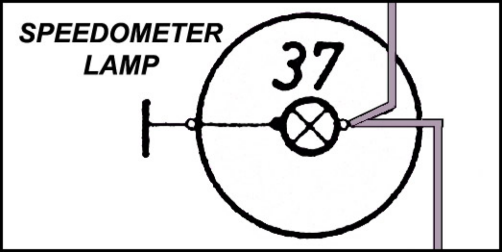
30

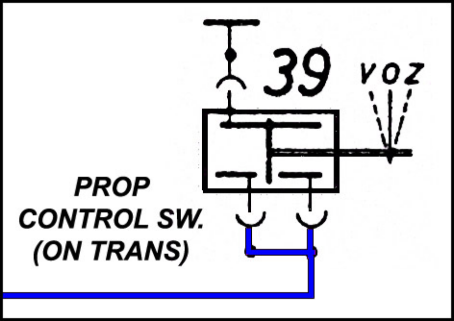
HORN BUTTON


31 - Ammeter Lamp
32 - Fuel Gage
33 - Directionals
34 - Instrument Lamp
36 - Oil Pressure
38 - High Beams
51 - Water Temp Gage
G
Bk
32
31
36
34
Br
38
33
Gy
51
Rd
15/54

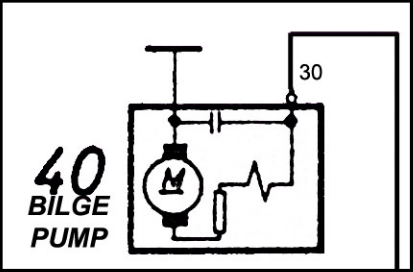


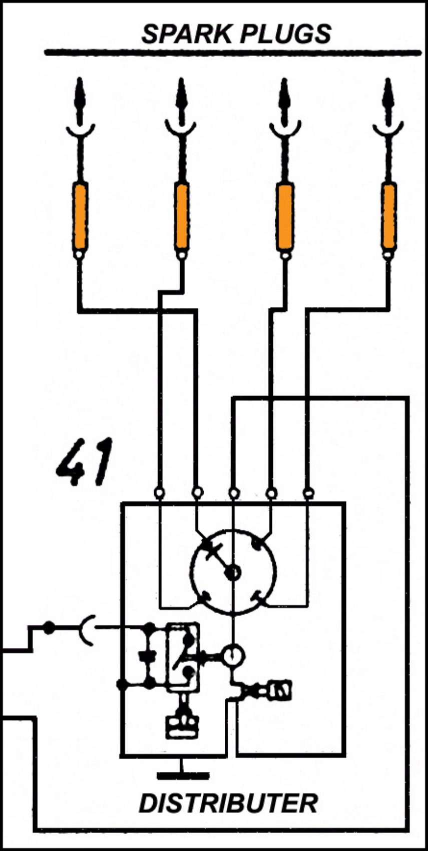
WATER DRIVE
CONTROL LAMP

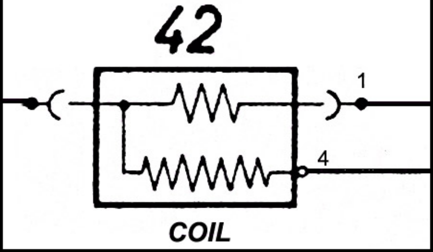

SPEEDOMETER
LAMP
37

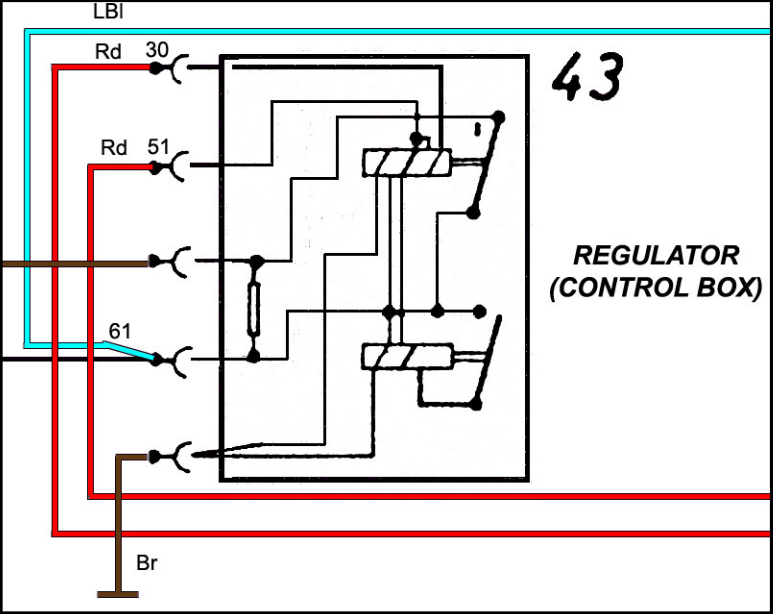


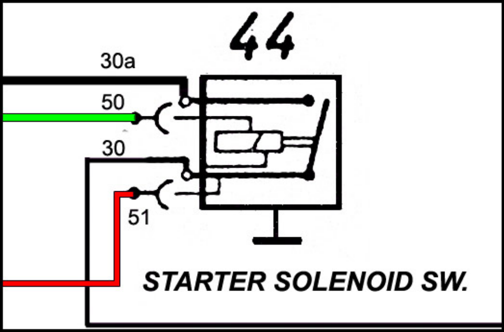
39
VOZ
PROP
CONTROL SW.
(ON TRANS)

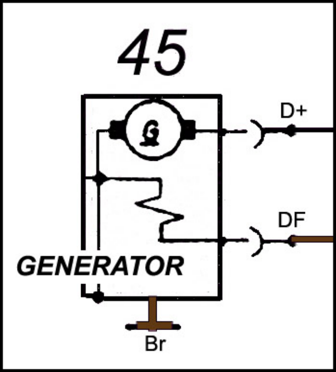

30
M
40
BILGE
PUMP


SPARK PLUGS
41
DISTRIBUTER

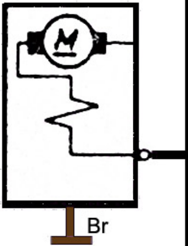

42
1
4
COIL

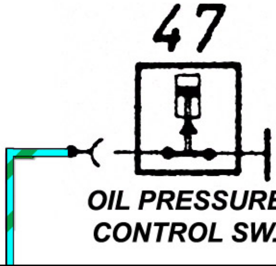

LBl
Rd
30
Rd
51
61
Br
43
REGULATOR
(CONTROL BOX)


44
30a
50
30
51
STARTER SOLENOID SW.

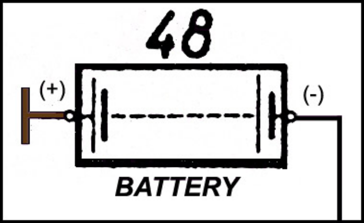

45
G
D+
DF
GENERATOR
Br

46
STARTER MOTOR

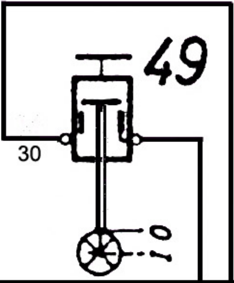




47
OIL PRESSURE
CONTROL SW.


48
(+)
(-)
BATTERY

BILGE PUMP SW.



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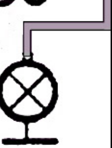
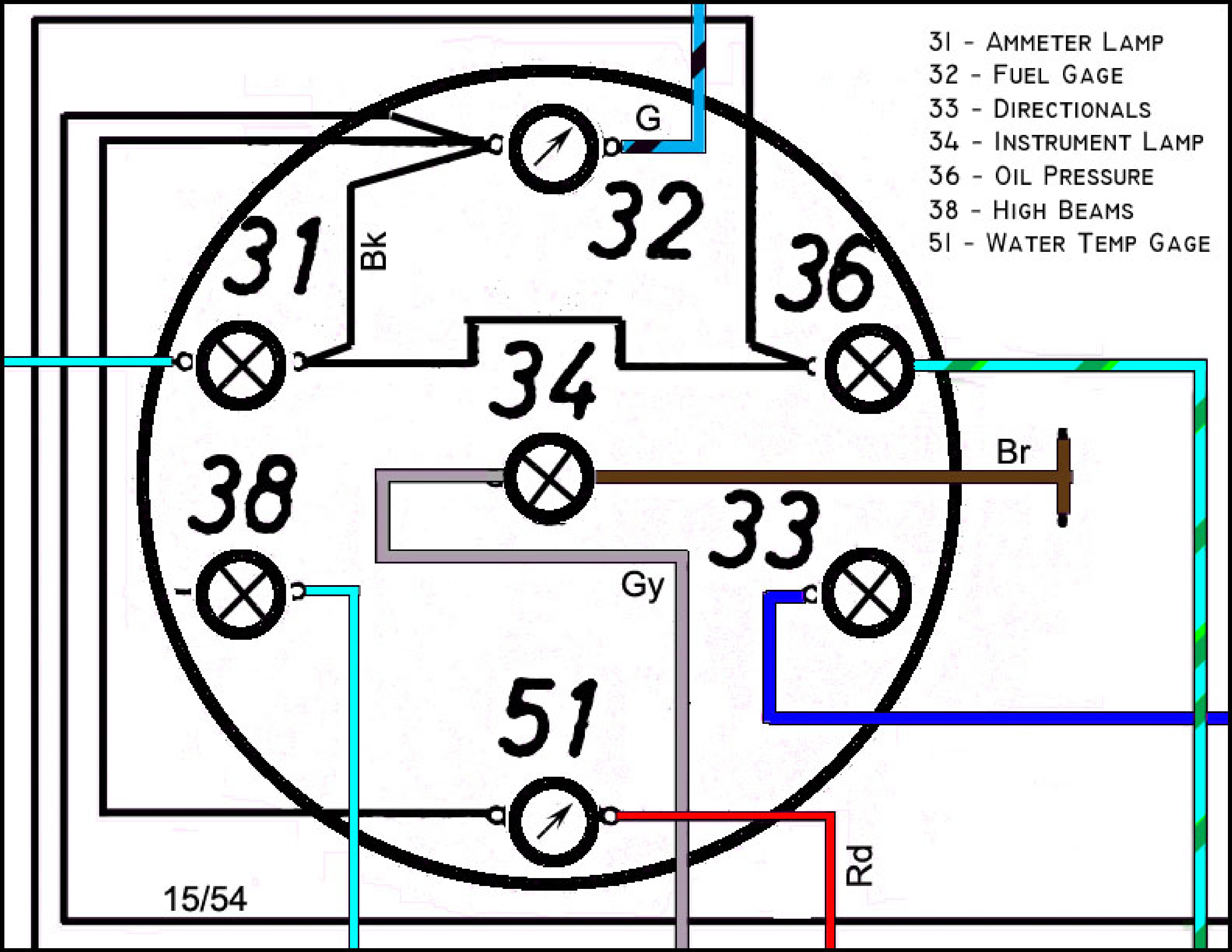
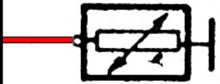


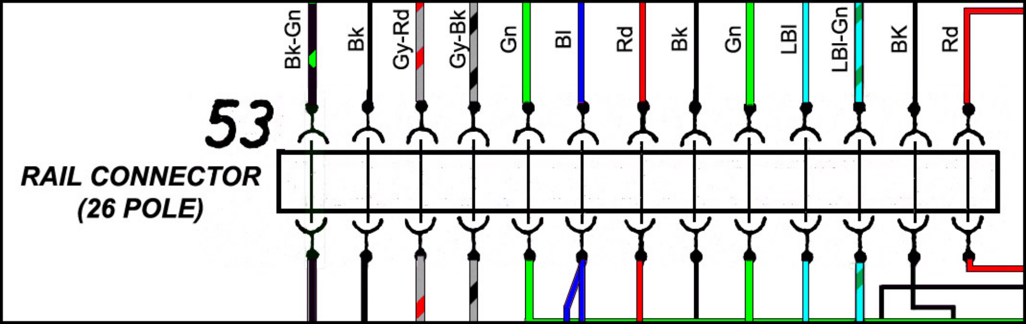
INTERIOR LAMP


31 - Ammeter Lamp
32 - Fuel Gage
33 - Directionals
34 - Instrument Lamp
36 - Oil Pressure
38 - High Beams
51 - Water Temp Gage
G
Bk
32
31
36
34
Br
38
33
Gy
51
Rd
15/54

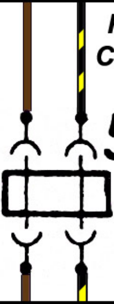


52

WATER TEMP.
SENDING UNIT

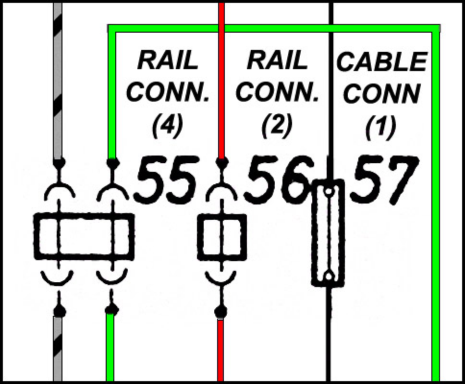


Bk-Gn
Bk
Gy-Rd
Gy-Bk
Gn
Bl
Rd
Bk
Gn
LBl
LBl-Gn
BK
Rd
53
RAIL CONNECTOR
(26 POLE)

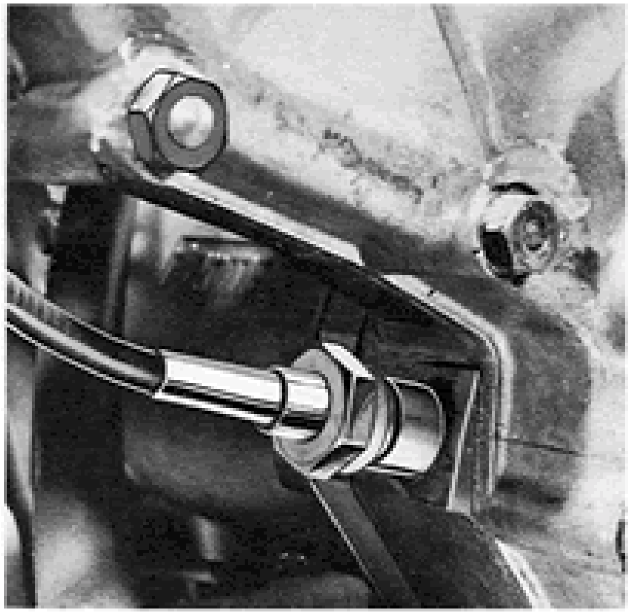


RAIL
CONN.
(4)

54


RAIL CONN. (4)
RAIL CONN. (2)
CABLE CONN (1)
55
56
57

INDEX



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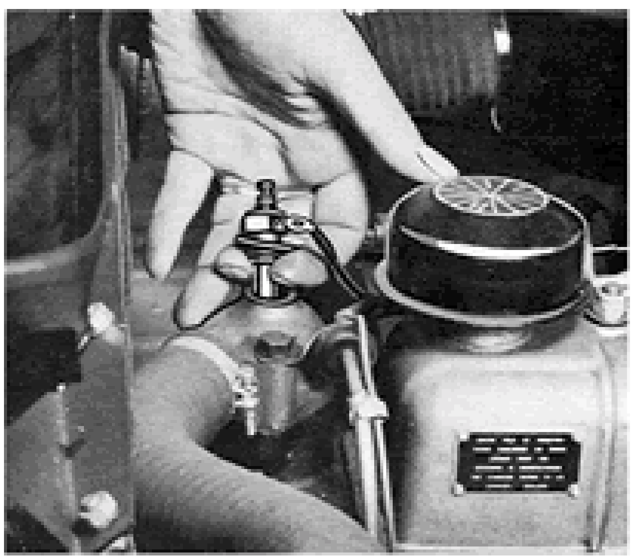

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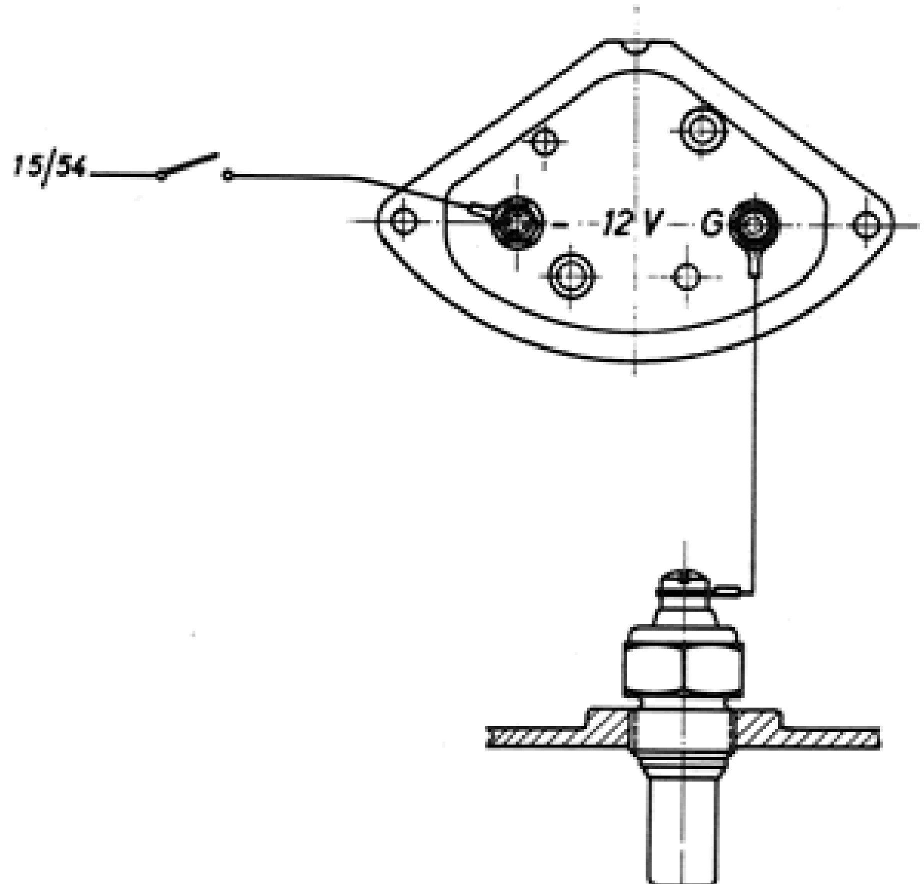


INSTRUMENTS

SPEEDOMETER

The speedometer is mounted on the instrument panel by means of a fixing bracket and two knurled nuts.

Measuring range:	0 to 90 M.P.H.
Odometer range:	100,000 miles

Speedometer repairs may only be effected in specialized workshops.

SPEEDOMETER CABLE

The flexible speedometer cable leads from the speedometer drive in the gearbox through the bilge, the trunk and over the firewall to the speedometer.

To dismantle the speedometer cable, it is necessary to dismantle the rear seat, the rear seat base, the front seat and the floor.

Disconnect the speedometer cable from the instrument and from the drive in the gearbox (Fig.1), unbend fixing clamp and remove the outer cable from the gearbox bracket. Remove the cable by pulling at center.

When re-assembling, slide the outer cable over the inner cable before mounting.

The dismantling of the speedometer drive is described in group 2, page 9.

It is not necessary to dismantle the housing cover for the disassembly of the speedometer drive. Dismantle only the stud bolt below the drive. The speedometer drive must be removed with the special tool AC 44.

COMBINED FUEL GAUGE AND TEMPERATURE GAUGE

Two fixing brackets with one knurled nut each hold the instrument in the instrument panel.

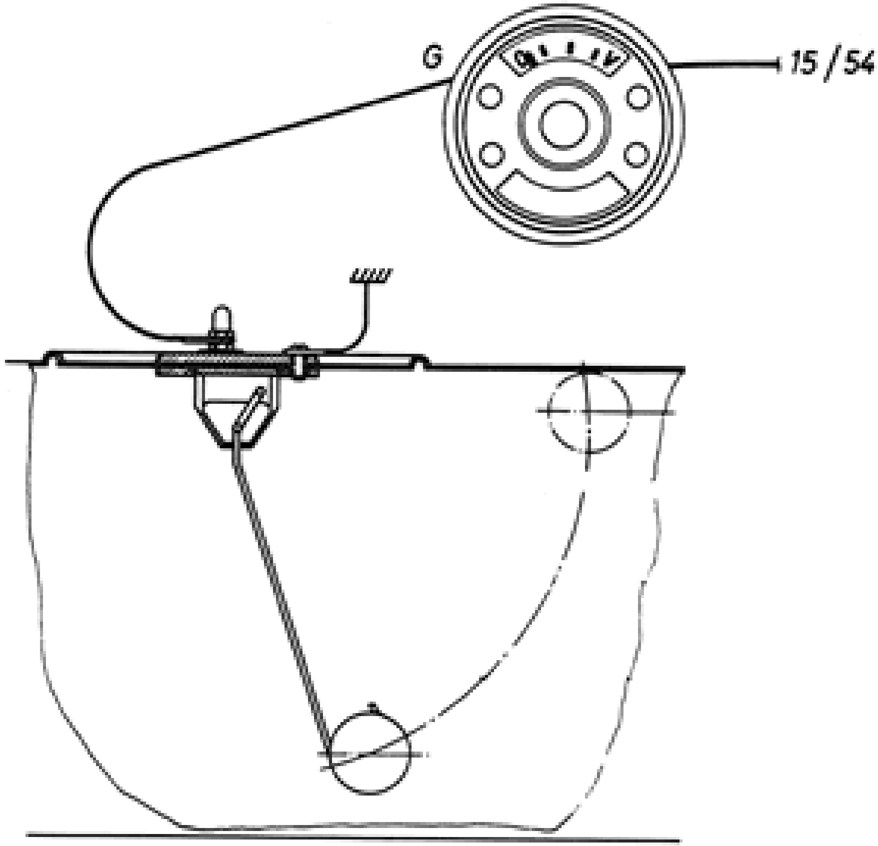
The water temperature gauge is operated electrically by the temperature unit mounted in the thermostat housing (Fig.2).

The minus cable leading from the temperature unit is connected to contact G (Fig. 3).

In case of failure check if all contacts at the instrument, the temperature unit and at the ignition switch are all properly connected.

To find a defect in the temperature unit, disconnect the cable at the temperature unit and ground it. If the gauge reacts, then the temperature unit must be replaced. After re-assembly, check for possible leakage.

If the gauge is found to be defective, the entire instrument must be replaced.



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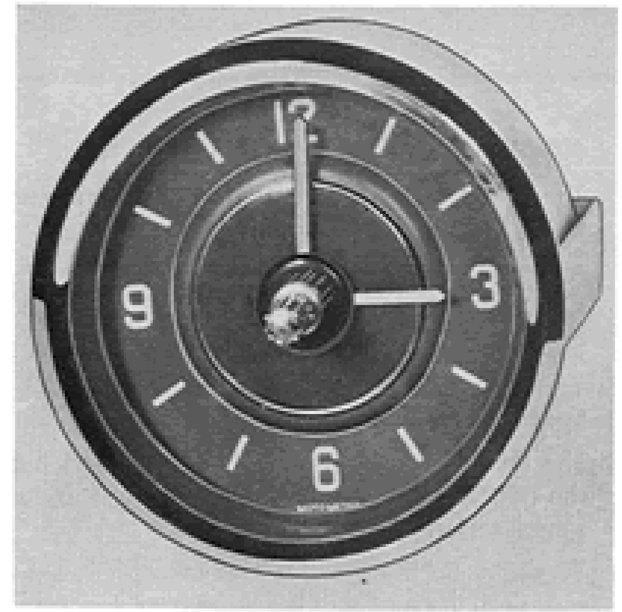
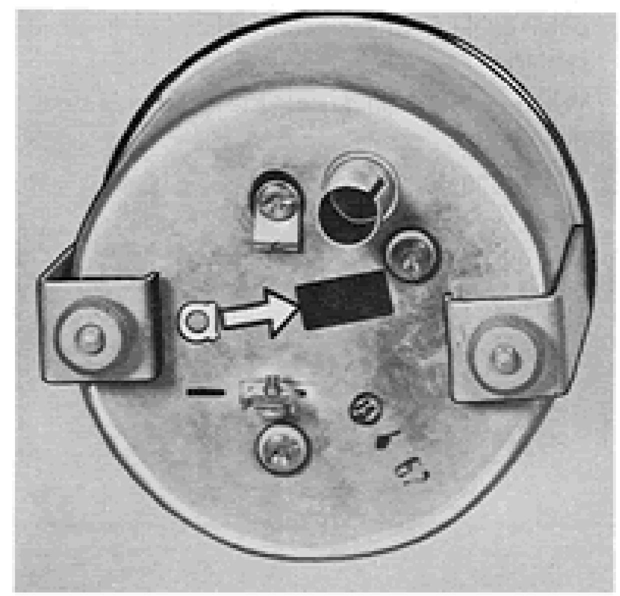




2

FUEL GAUGE

Fuel gauge is operated electrically.

A resistor in the tank unit is operated by means of the float (Fig. 1).

The fuel tank unit and the fuel gauge are properly adjusted by the manufacturer. If incorrect indications are found, check the contents of the tank and correct the adjustment of the float-arms by bending.

If the resistor in the fuel tank is defective, the complete fuel tank unit must be replaced.

A defective float may also result in an incorrect indication in the gauge.

When mounting the fuel tank unit, make sure that the float-arm points to the filler cap and that the seal is properly placed.

If the fuel gauge is defective, it must be replaced.

The minus cable leads from the center-contact of the fuel tank unit to contact G.

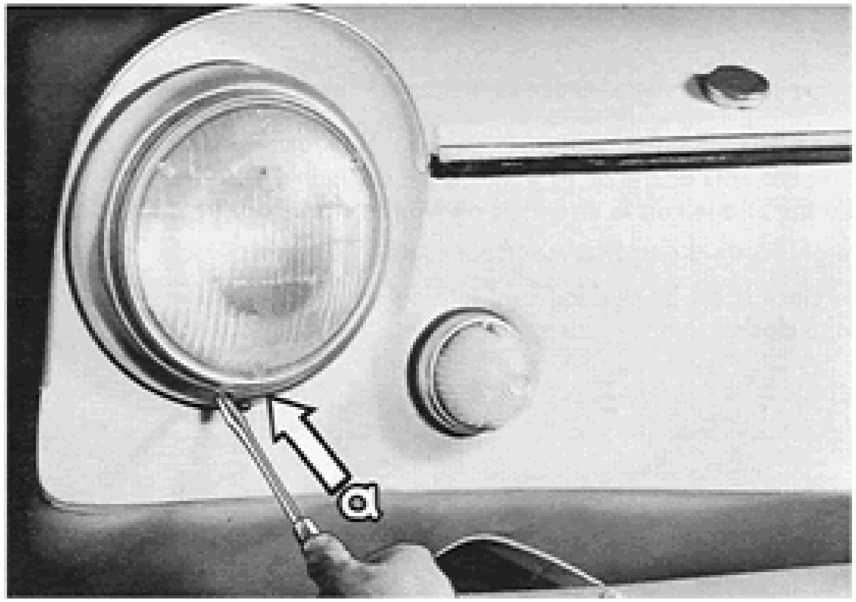
An improper grounding connection may also result in disorders in the instrument (the cable connector lies under the mounting of the flasher unit).

ELECTRIC CLOCK

The electric clock in the instrument panel is mounted by means of two fixing brackets and knurled nuts, and is accessible from the trunk. The adjustment opening is arranged above the clock housing (Fig. 2).

The plus-current supply comes from contact 30 (ignition lock).

The clock is set by pushing and turning the knurled nut in the center of the clock.



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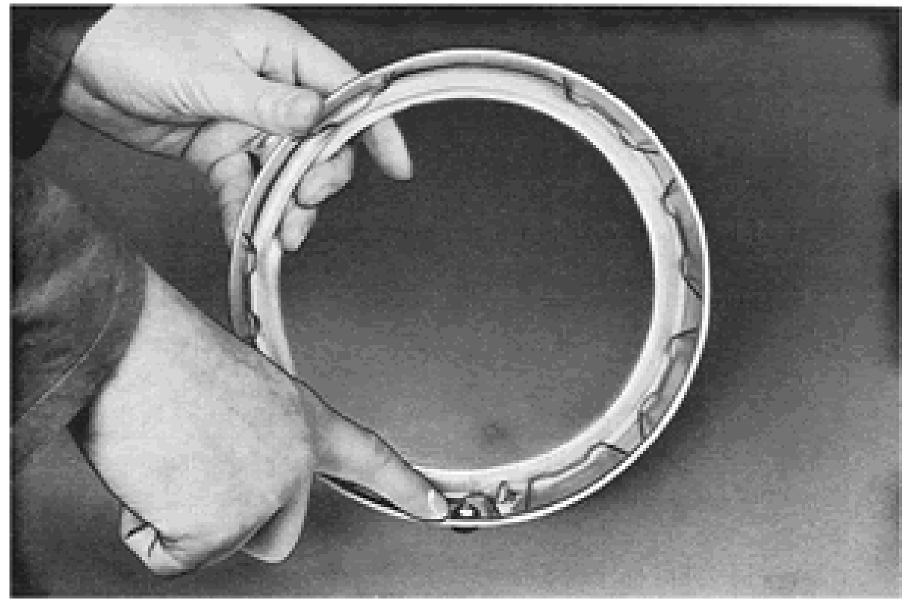

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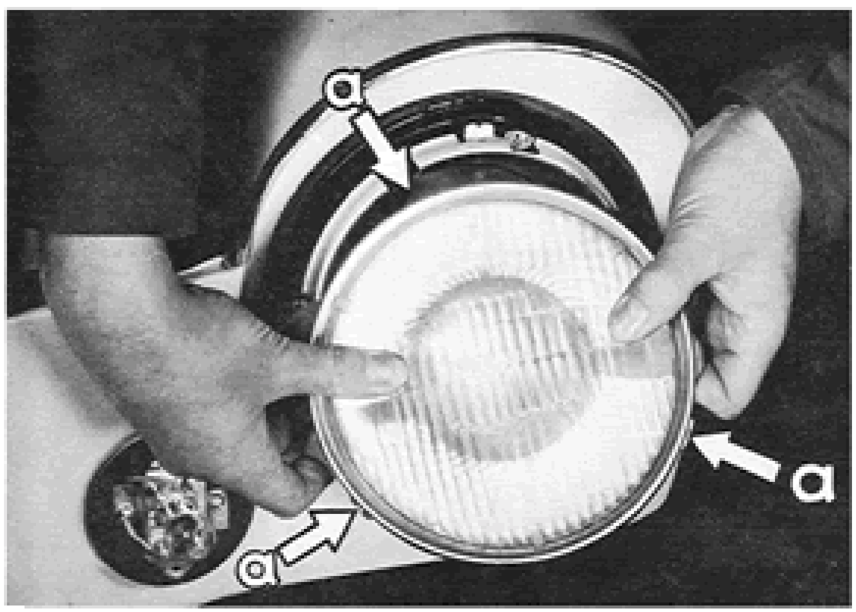

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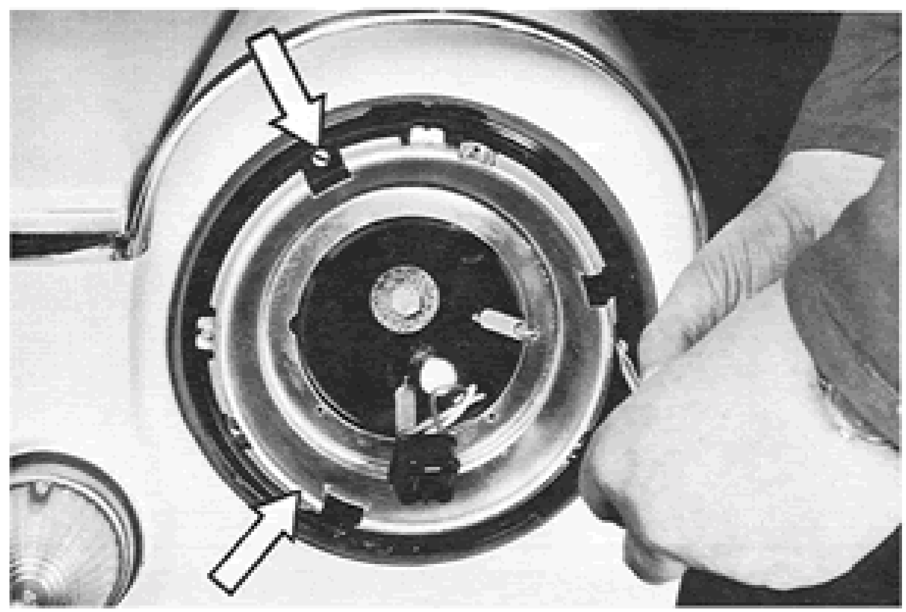


4

HEADLAMPS

Two headlamps, each with a sealed-beam unit. The foot dipper switch is mounted on the toe board. A two position push pull switch on instrument panel controls parking lights and headlights.

High beam indicator light is in the fuel/water temperature gauge.

DISMANTLING THE HEADLAMPS

Remove rim as show in fig. 1. After loosening the holding screw, carefully remove rim with screwdriver (near holding screw) (Fig. 1 a).

If the sealing rubber is to be replaced, coat with Vaseline prior to inserting in rim.

The eight retaining clips are to be distributed evenly along the circumference, in order to achieve a flawless joining of the sealing rubber (Fig. 2). Take care that the valve at the bottom of the rim functions is perfectly. The valve will close when water pressure is applied from the outside, and will open when traveling on land, letting any water that might have entered flow out.

For further disassembly, loosen the three mounting screws of the glass retaining ring (Fig.3a). Pull forward glass retaining ring with sealed-beam unit and pullout the cable connector socket from the sealed-beam unit. Remove glass retaining ring from body (Fig. 3,), being sure that round seals in retaining ring is not damaged.

Damaged seals must be replaced by new ones.

Assembly is in reverse order. It is absolutely necessary to grease with Vaseline the contacts of the cable connector socket, as well as the body clamps and the cable ends to prevent corrosion. Dismantle entire headlamp assembly, as follows:

If adjusting ring is defective, remove the three cylinder screws and remove adjusting ring (Fig. 4).

To dismantle the headlight shell assembly it is necessary to loosen the holding bracket that is connected to the shell with a screw.

The mounting screw is accessible from the trunk.

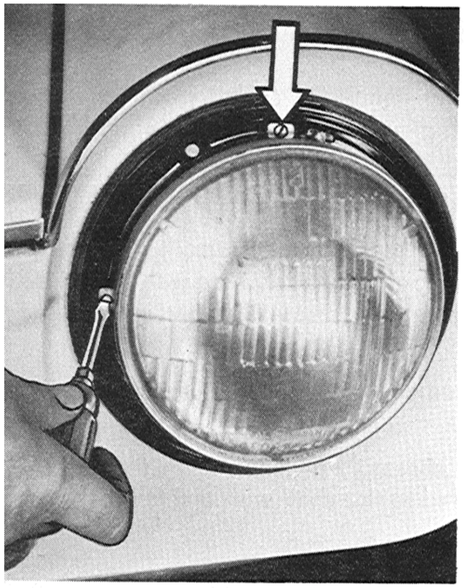
Push out shell towards front.

When reassembling, replace dust excluder rubber ring.

Tight fit is essential.

HEADLAMP ADJUSTMENT

When adjusting the headlamps, it is recommended that the vehicle be loaded with one person.



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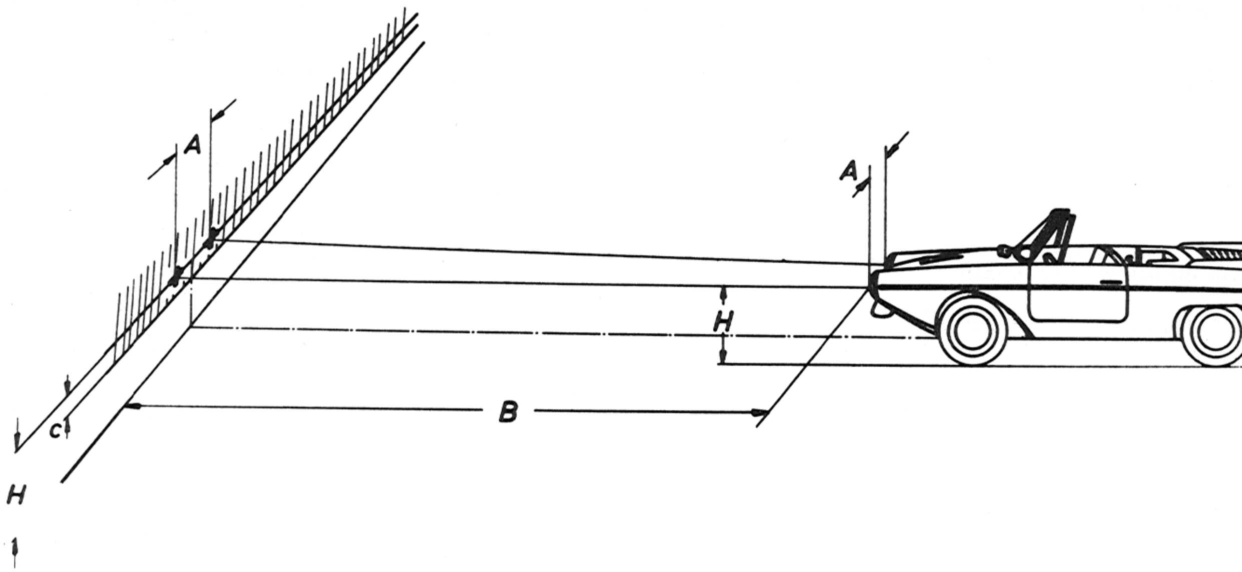

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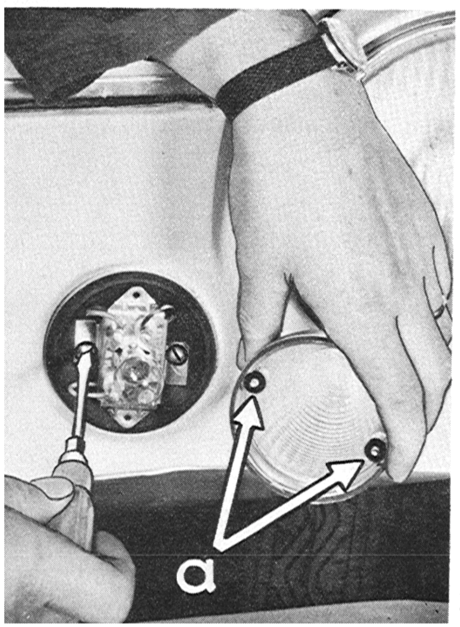

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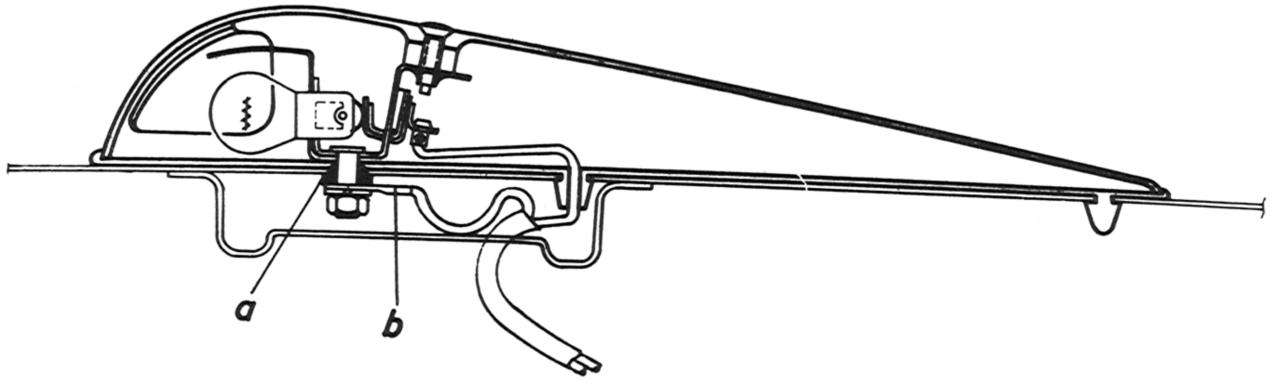


4

Place the vehicle on a level surface at a distance of 16 1/2 ft. from a flat wall (Fig. 2b). The tire pressure must be corrected to 14 psi front & 30 psi rear before the adjustment. Switch on low beams and, using the adjusting device (Fig. 1), adjust so that its light-dark border forms a straight line on the testing surface.

This line should be 2 inches lower than headlamp centerline (Fig.2c). For the high beams, use the horizontal setting.

For this, determine the vertical line on the testing surface and both light beams must fall on the testing surface evenly spaced. (See fig. 2a.)

Two front signal and parking lights are mounted below the headlamps and have one bulb each:

signal light 18 W

boundary light 4 W.

The direction indicators can only be turned on by the direction indicator switch after ignition has been switched on. A direction indicator light in the fuel/water temperature gauge requires a 2 W bulb.

The parking lights work in conjunction with the tail lights. To exchange bulbs, loosen the light shell (2 mounting screws) (Fig.3a).

When reassembling, be sure that the sealing rubber lip surrounds the lens, to assure a faultless sealing.

If the entire parking light is to be replaced, loosen the two screws holding the base of the light (Fig. 3). The nuts are all accessible after removal of the false bottom of the trunk.

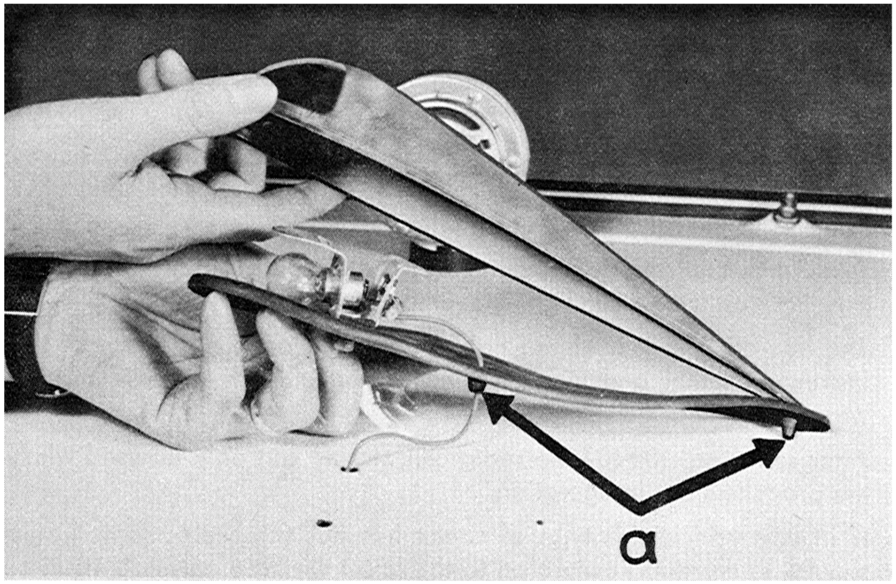
A red/green marine light, mounted on the trunk lid, is used only when traveling on water. The light is equipped with a 18 W bulb.

The operating switch of the light is mounted on the left side of the instrument panel and may be switched on only when traveling on water.

After serial no. 103 602 the red/green marine can only be used when the propellers are in operation.

If in any vehicle this type of circuit has not yet been adopted, this should be corrected according to the latest wiring diagram S 10/22-1.

The diagram explains all the necessary conversions to be made (Fig. 4).



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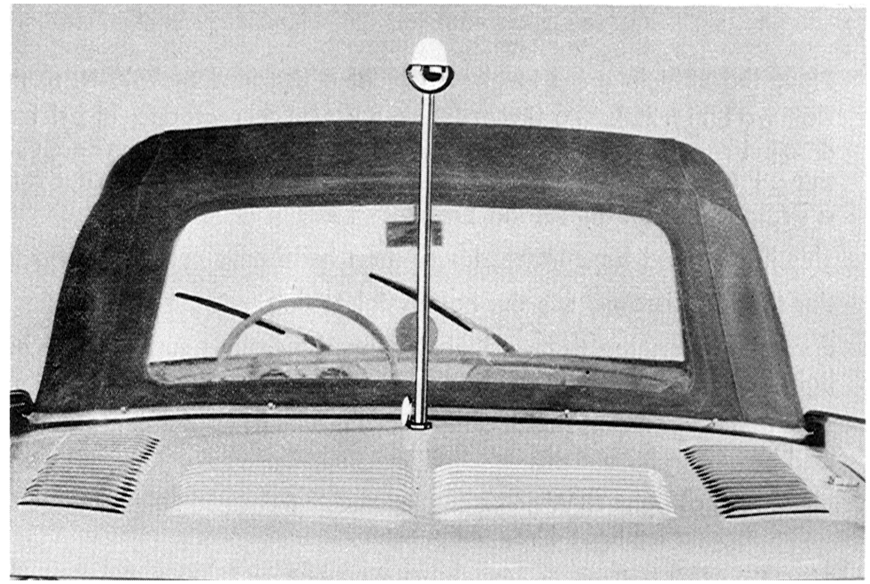
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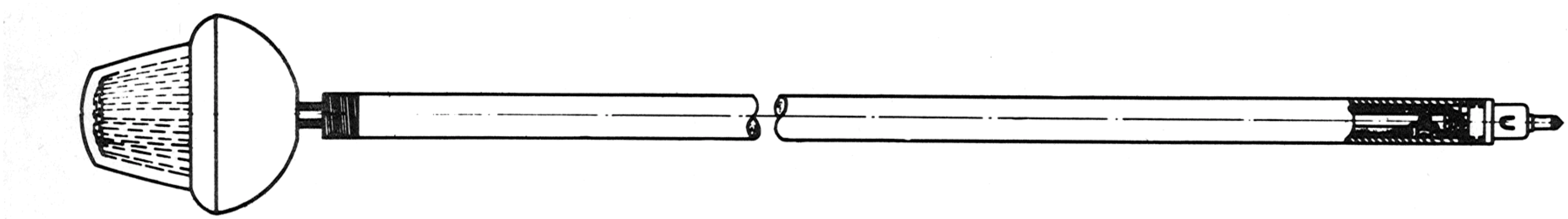

3

The modification consists of:

A/ An insulating bushing must be placed on the securing bolt and the hole in the trunk lid must be enlarged.

This prevents the cable from shorting on the bolt.

B/ The marine light on the trunk lid is directly connected to the water transmission control switch.

To replace the bulb, remove the cover which is attached to the base of the light by means of a screw.

When assembling, make certain that the light cover fits well into the sealing rubber. When replacing complete light, the cover must be separated from the base during the assembly.

The rubber grommets must be inserted into the hood then the base is mounted (see Fig. 1 a), the cable is connected and the cover is mounted.

Top position light rear, in the form of a white 360° light and equipped with a 18 W bulb.

This light is used as a position light when traveling on water, being plugged in, for this purpose, into the plunger contact located in the engine hood, under the center catch cover (Fig.2). This light may be used only for water travel because the vibrations of the vehicle during land travel could cause damage to the plunger contact and to the hood.

During land travel the light is fastened to the rear backrest.

The top position light is operated by the switch on the instrument panel (and burns together with the red/green position light on the trunk lid).

Fig.3 shows a schematic of this light.

To replace the bulb, dismantle the white lens, which is fastened by means of two screws. If the sealing rubber is damaged between the lens and base, it must be replaced by a new one.

COMBINED TAIL AND STOP LIGHTS

Each equipped with a bifilar bulb of 18/5 wcp.

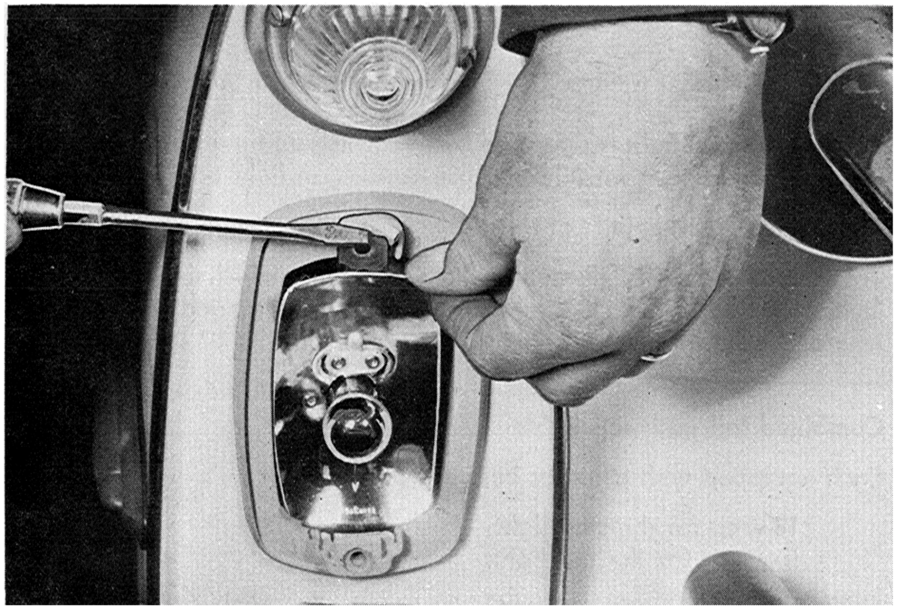
18 w cp for the stop light,

5 w 4 cp for the tail light.

The tail lights are switched on by the headlamp switch and burn in the first and second positions together with the front parking lights.

The stop lights are combination lights and serve alternately as stop or signal lights.

The stop lights are activated when braking, after the ignition has been switched on, by the hydraulic stop light switch on the master brake cylinder.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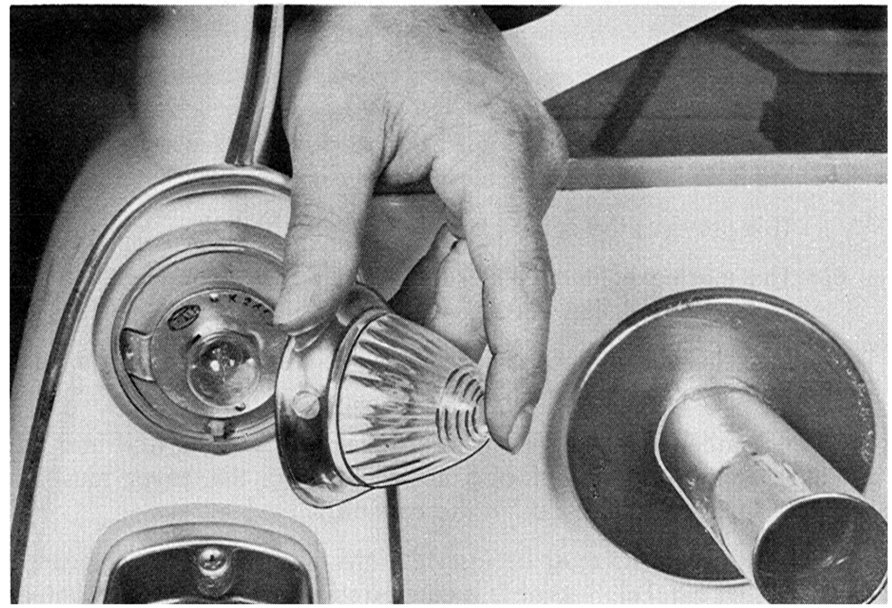
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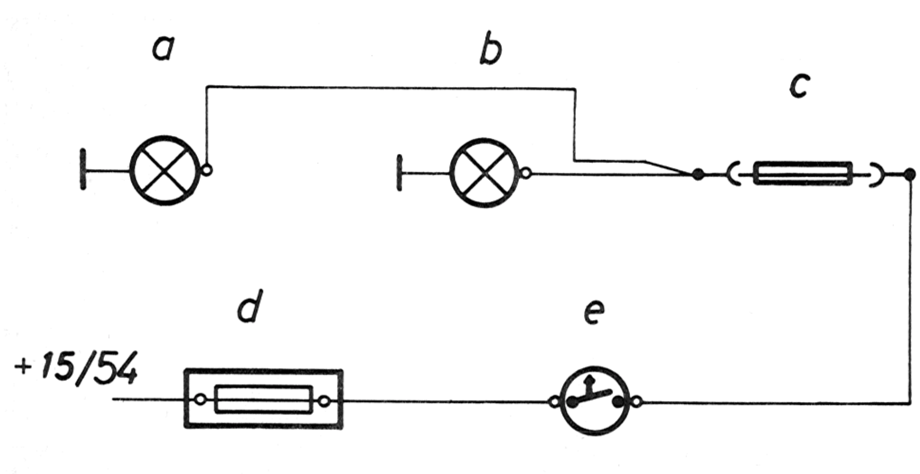

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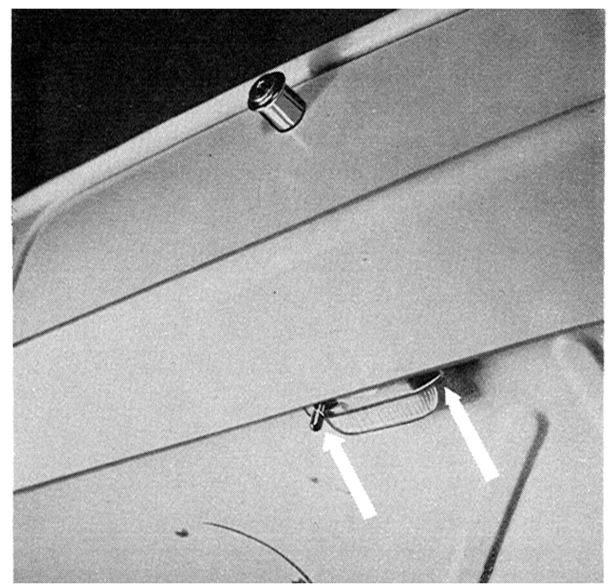
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The signal lights are activated, after the ignition has been switched on, over the same circuits as the stop lights, through the direction indicator switch.

When the signal lights are switched on, the green control light (with a 2W bulb) in the combined fuel/temperature gauge lights up in coordination with the impulses emitted by the flasher unit.

The bulb can be replaced after the two mounting screws holding the lens and the rubber base have been loosened. To dismantle the light further, remove the reflector from the rubber base (Fig. 1).

Assembly is in reverse order. Special care must be taken when fastening the lens. The rubber lip of the base must be fitted tightly to the lens, and the sealing rings must not be missing from the mounting screws, as otherwise water would enter the light.

TWO LICENSE PLATE LAMPS

Each equipped with a 4 W bulb.

The license plate lamps are connected with the left tail light.

After loosening the two mounting screws, the lens with sealing rubber and base is dismantled. If the sealing rubber is defective, it must be replaced. The light base and socket must be greased with Vaseline to prevent corrosion.

Two reversing lights (left and right) — are arranged above the combined tail and stop lights, equipped with one bulb of 18 W each.

Wiring diagram (Fig.3) shows reverse light system.

Reverse lights — left and right.

Cable connector.

Fuse.

Switch — mounted on gear shift rod.

They light up only when the ignition is switched on and the gear lever is set to reverse for land travel.

The lens is held by two mounted screws. After removal of the screws, the lens can be removed and the bulb can then be replaced (Fig. 2).

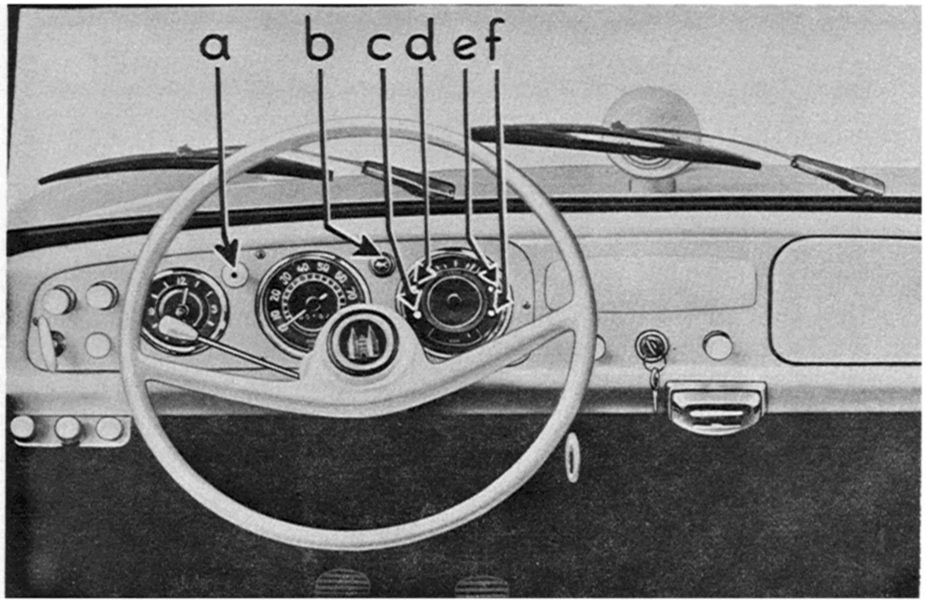
To dismantle the complete light, remove the nut which is accessible from the engine compartment.

When mounting a new light, place the base with the sealing rubber first, and then screw on the lens. When mounting the lens, be sure that the sealing rubber fits closely.

One inside light, with built-in switch and a 5 W bulb, situated on the right side below the instrument panel (strip lamp).

This light can be switched on independently of all the other lights or switches.

To replace the bulb, the lens, which is fastened by screws, must be dismantled.



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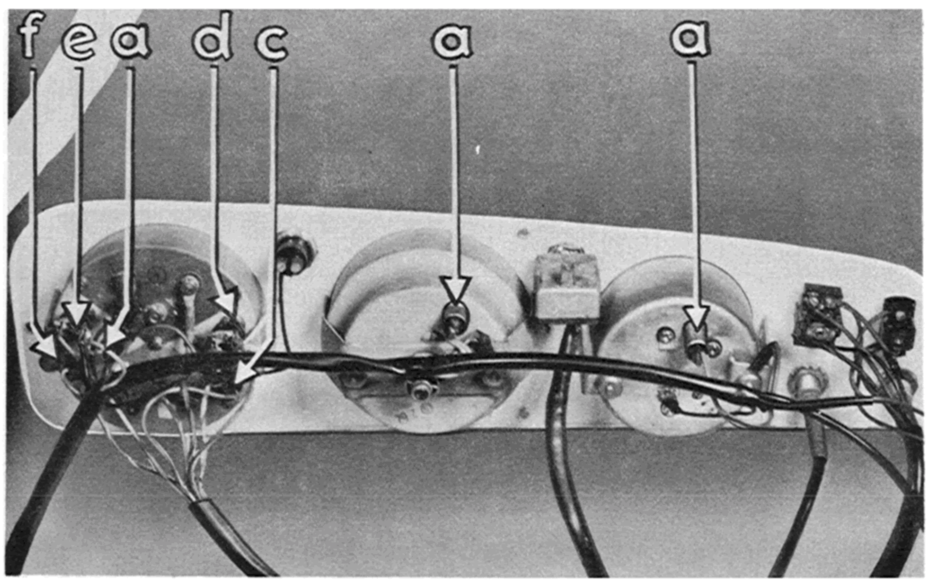

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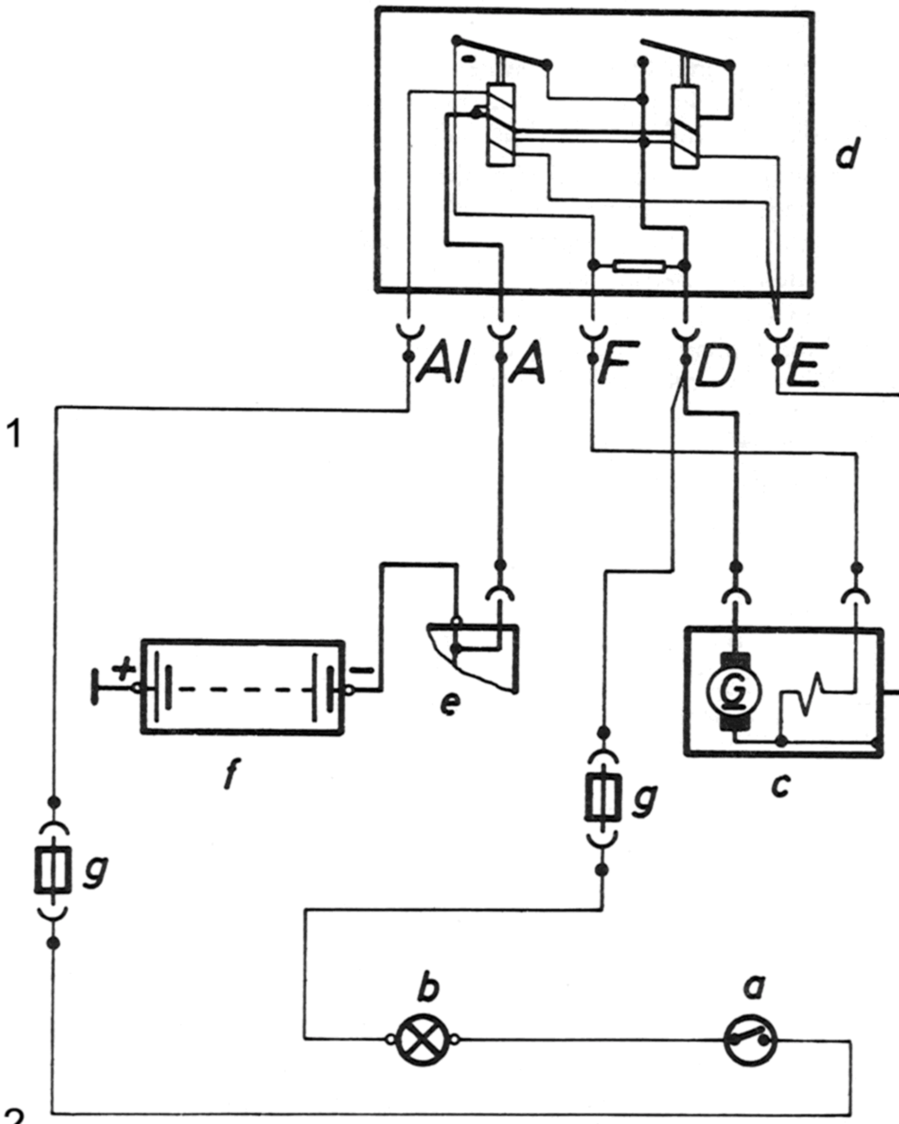

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Instrument lighting, consisting of one 2 W bulb each placed in the electric clock, the combined fuel gauge and temperature gauge, and the speedometer.

It is in the form of an indirect dial lighting. It is switched on by the main light switch in the first and second positions.

The instrument (Fig. 2a) and control lights (Fig. 2c, d, e, f) are equipped with plug-in sockets. To replace bulbs, they are pulled out from the mounting from the rear (accessible from the trunk).

Control lights in the combined fuel gauge and temperature gauge, each with a 2 W bulb.

Fig. 1f **Red control light for high beams.**

This is a one-pole control light socket. The light is connected in parallel with left front headlamp.

Fig. 1c **Green control light for direction indicator.**

This is also a one-pole control light socket. It is connected with the flasher unit.

Fig. 1d **Orange control light for oil pressure gauge.**

The control light socket is bipolar. It is under pressure when the ignition is switched on. The ground wire is controlled by the oil pressure switch. The switch has a current flow to the ground only when there is no oil pressure.

Fig. 1e **Blue control light shows no charge from the generator.**

This is a bipolar socket with a lead-wire from the ignition and a ground wire over the generator brushes.

Fig. 3 shows the wiring circuit.

a/ Ignition switch.

b/ Blue "no charge" light.

c/ Generator.

d/ Regulator.

e/ Solenoid switch.

f/ Battery.

One yellow control light for water travel (Fig. 1 b)

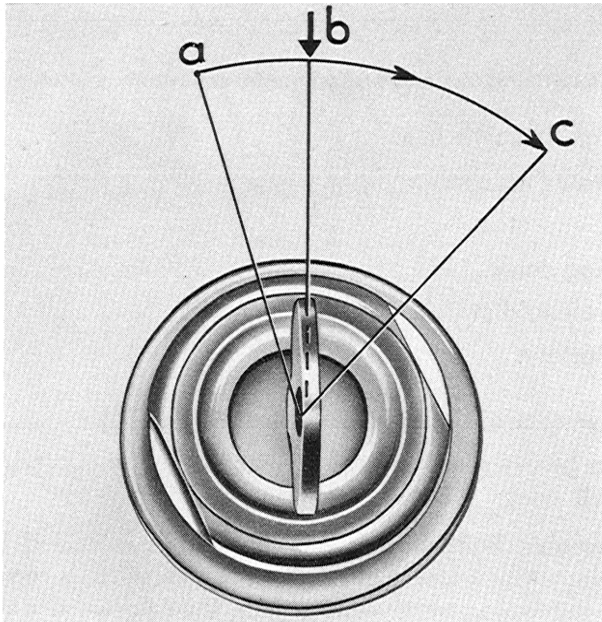
This is a larger – sized control light separately mounted on the instrument panel.

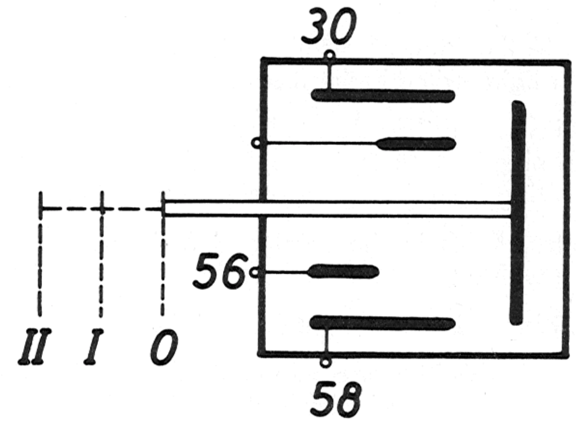
It is a two-pole light with a 2 W bulb. It is intended as an optical control when the water transmission gear shift is engaged. Upon engaging the water transmission gear shift (forward and backward), the gear lever activates a contact switch which completes, for the light, the circuit to the ground.

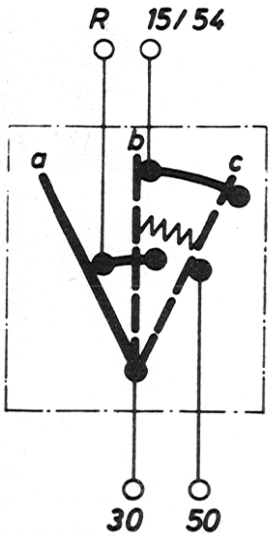
To replace the bulb, the window cap must be unscrewed.

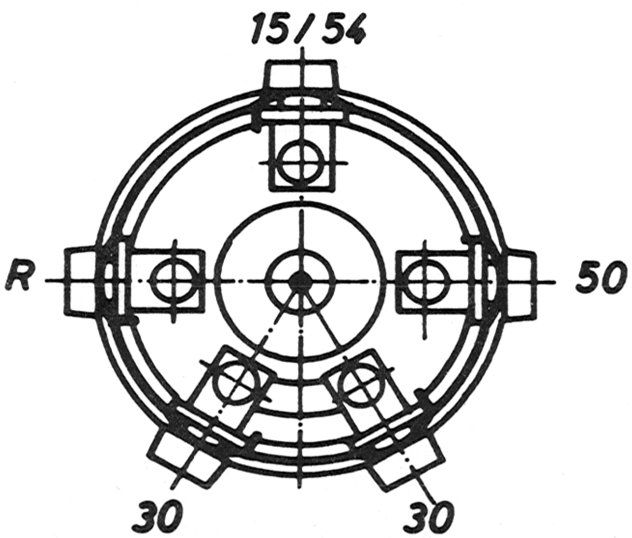
A blue control light in the electric bilge pump switch (Fig. 1a) on the instrument panel, is equipped with a 1.2 W bulb. It lights up when the bilge pump switch is on.

To replace the bulb, unscrew the switch knob.









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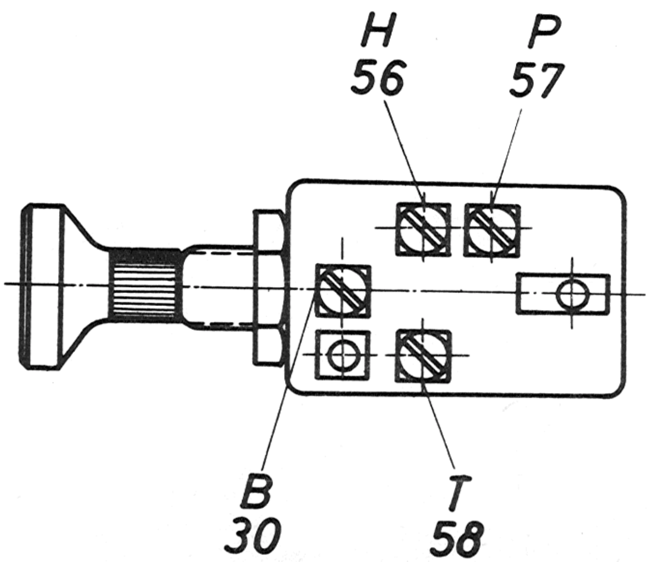


SWITCHES, RELAYS AND ELECTRICAL EQUIPMENT

IGNITION SWITCH

The ignition switch (Fig. 1) has a key which also fits the door-lock and the glove compartment lock.

The ignition switch has the following switch positions:

a/ Off — all controls.

b/ On — radio & lights can be operated.

c/ Ignition — key returns to on position.

DISMANTLING

To dismantle the ignition switch, remove the ring nut on the instrument panel. After the cable connections have been disconnected the ignition switch is removed. (See wiring diagram for connections.) (Fig.1.)

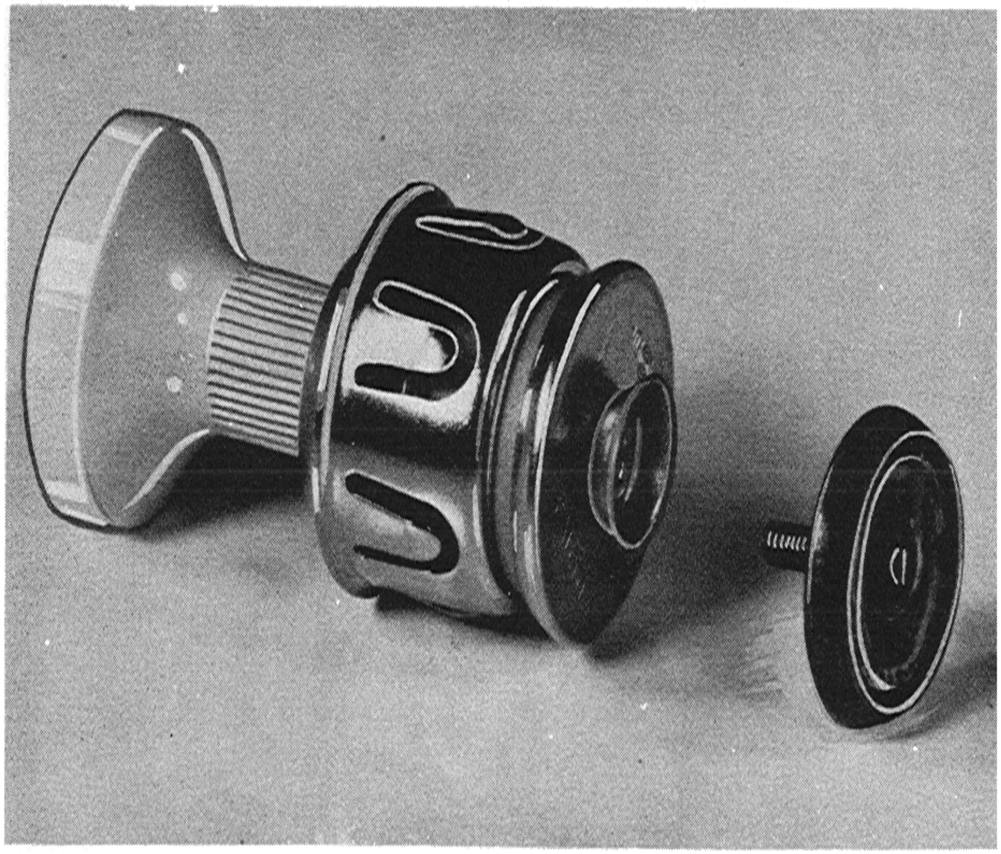
The ignition switch cannot be taken apart for repairs.

This, however, should not become necessary, for as far as mechanical and electrical reliability of operation is concerned, it has been designed in such a way as to have a practically unlimited life. If an ignition switch is found to be defective, it must be replaced.

LIGHT SWITCH

This switch of the push/pull type has three positions -viz:

1. Off.
2. Side lamps, tail lamps and instruments lights.
3. Headlights.



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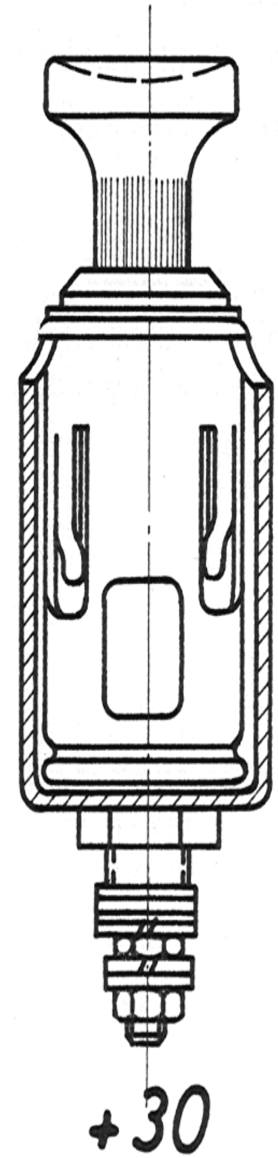

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To dismantle the switch, remove the knob and the ring nut. After disconnecting the cable ends, from the trunk, the switch can then be lifted out.

NOTE: When assembling, be sure that:

1. Cable ends must not protrude all the way through the terminals, otherwise a short may occur.
2. The switch should be positioned so as to eliminate any possible shorting to the instrument panel.

   If a defect occurs in the switch, it should be replaced and not repaired. (For connections, see wiring diagram.)

CIGARETTE LIGHTER

The cigarette lighter on the instrument panel consists of two parts:

a. The lighter with lighter elements,

b. The socket.

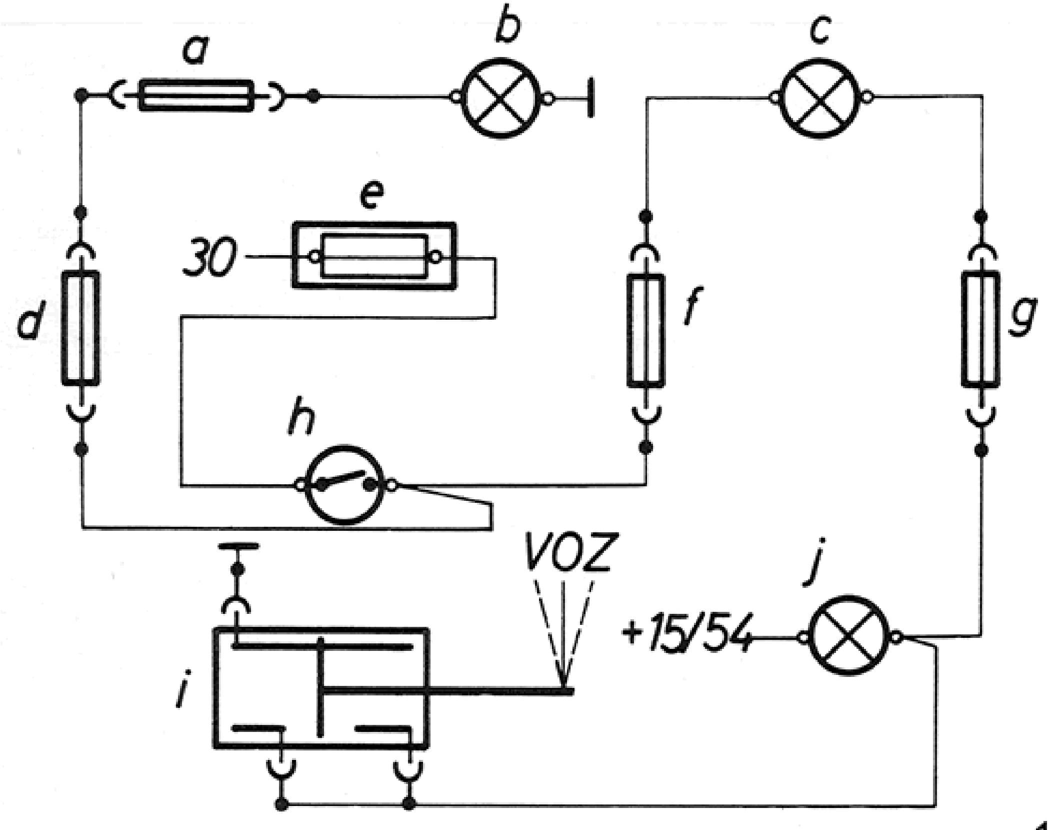
After depressing the knob into the notched position, the knob will snap out automatically after about 15 seconds.

The current consumption is about 100 W.

Dismantling of the socket is done from the trunk.

After disconnecting the cable, insulate the cable end, as the line is not protected by fuses.

The holding nut is loosened and removed together with the bracket. The lighter element, if defective, may be replaced by being unscrewed (12 V!) (Fig. 2).



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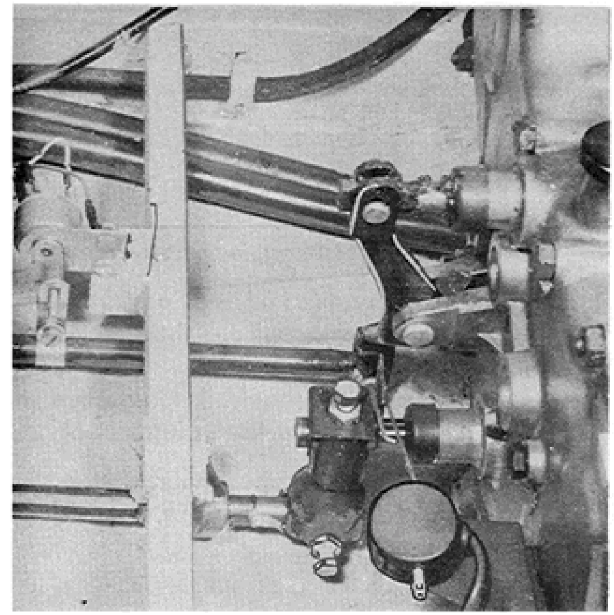

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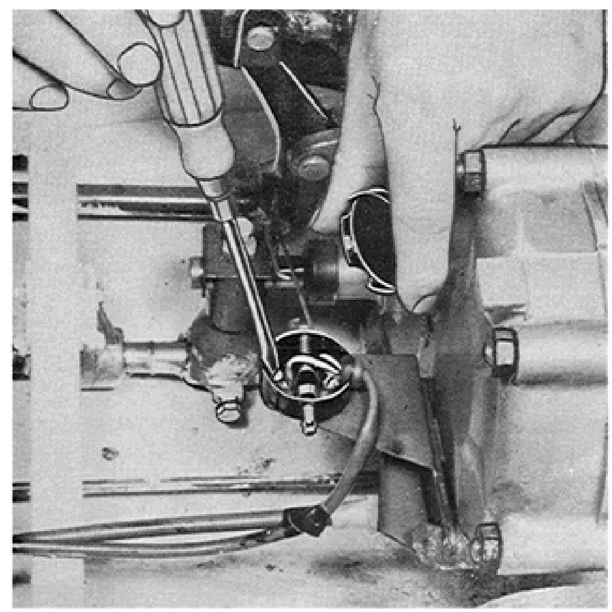

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SWITCH FOR MARINE LIGHTING

The switch is mounted on the upper left side of the instrument panel.

It is a single-stage switch with
position 0 - normal position (circuit not completed),
position 1 - switch button pulled out red/green front light and white rear light on.

To dismantle the switch, unscrew the switch button and the ring nut. Remove the switch through the trunk.

If difficulties arise when dismantling the switch, pull up the instrument panel after having unscrewed the holding screws of the panel and of the speedometer cable. The switch will then be accessible.

When re-assembling the switch, take care that no earthing could occur through the contacts.

The switch connections are described in fig. 1.

a/ Rear marine light socket.

b/ Rear marine light.

c/ Front red/green marine light.

d/ Cable connector - mounted on rear firewall.

e/ Fuse.

f & g/ Cable connector - mounted on trunk lid.

h/ Main switch - marine lights.

i/ Control switch (Fig. 2).

j/ Propeller light - yellow.

The **control switch** for water travel is mounted on the crossbar under the rear seat, in front of the gearbox (Fig. 2). This is a rotary switch which is in its neutral position when the switch lever is vertical.

When shifting the water transmission gear (forward or reverse) the switch is operated by means of the clamp mounted on the gear shaft.

The switch then completes the circuit of the yellow control light for water travel to the ground and provides the ground-lead for the red/ green marine light.

The wiring arrangement of the installation can be seen in fig.1.

After the assembly, check in the course of the operational test that the switch is properly actuated when the water gear lever is in the forward and in the reverse positions.

REVERSING LIGHT SWITCH

The switch is mounted on a mounting bracket at the front of the gear cover and is actuated by the shifting linkage through a wire clamp (Fig. 3).

In order to reach the switch, the rear seat and the seat base must be dismantled.

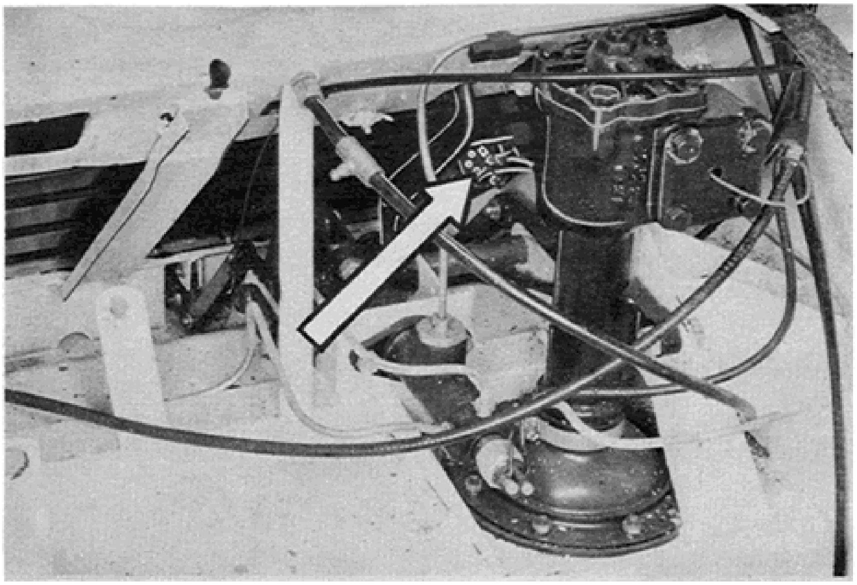
This is a contact switch which is switched off when it is in its normal position.

When the gear is in reverse, the control shaft is pulled out and thus the circuit of the two reverse lights is completed.

To dismantle the switch, remove the upper half of the switch housing in order to reach the mounting screws and the cable connections. When replacing the mounting screws use only the original Amphicar parts, as screw heads of larger size would be touching the switch contacts.

During the operational test check that the contacts are closed only in the reverse position. If the contacts are not closed adjustments must be made on the switch or on the actuating mechanism.

The wiring of the reversing light installation can be seen on page 10/14 fig. 3.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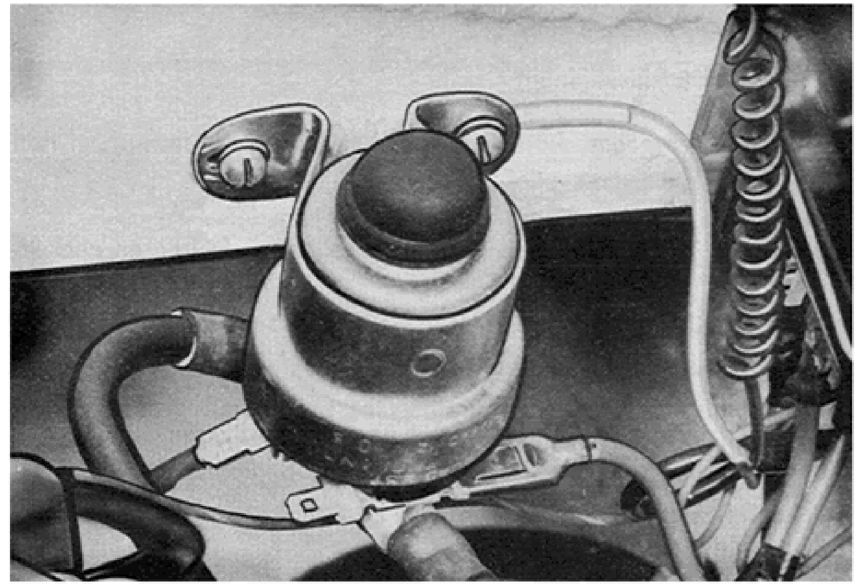
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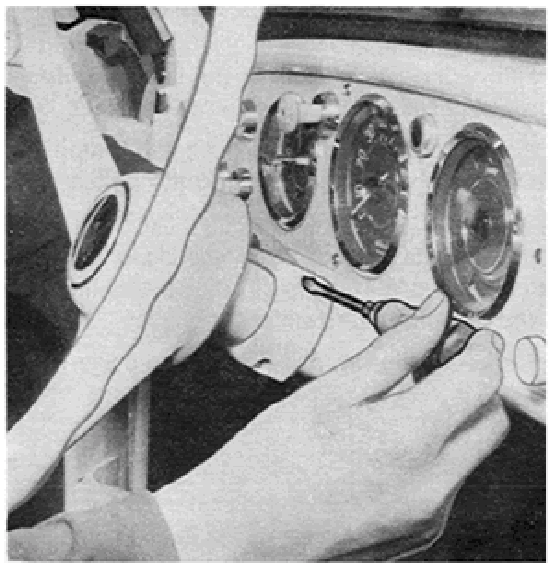
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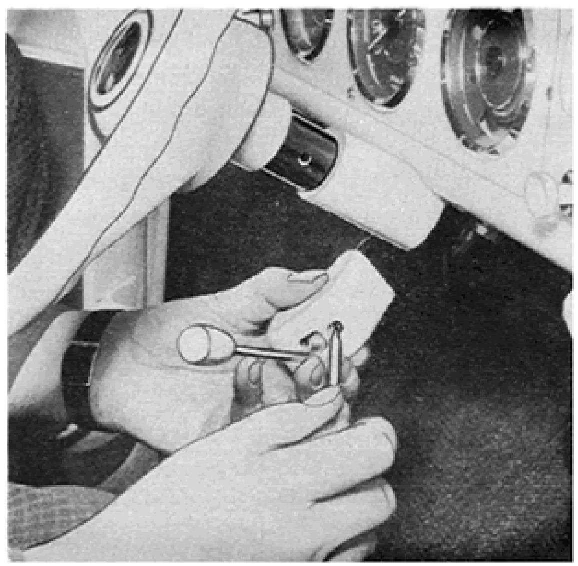
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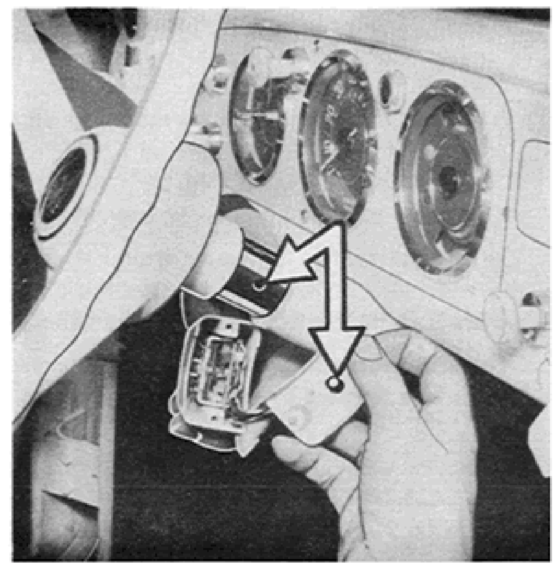
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FOOT DIPPER SWITCH

The foot dipper switch (circuit opening capacity up to 120 W) is mounted on the toe board below the clutch pedal.

To dismantle the dipper switch, the rubber mat must be removed from the toe board. Remove the two mounting screws, and the trunk panel, pullout the switch and disconnect the cable.

Re-assemble in reverse order.

NOTE: When assembled, the switch connections must point forward (Fig. 1).

If the switch is faultily mounted, the switch will be ruined when the pedals are operated, by a short circuit in the lead-in wire.

If the dipper switch becomes defective, it must be replaced.

Effective after serial no. 103 602, improvements in the dipper switch have been made by the factory. If a dipper switch of this new design is to be mounted, make sure that the securing screws have U.S. threads.

The cable clip must be replaced by an AMP plug at the cable ends.

The connections can be seen in the wiring diagram.

STARTER SOLENOID SWITCH

The solenoid switch for the starter motor is mounted on the engine partition, under the ignition coil (Fig.2). It is a combination switch which is actuated by the ignition switch.

1. Mechanically operated by the rubber push button on the switch.
2. Electro magnetically by completing the circuit.

The solenoid switch has the task of completing the main circuit of the starter motor.

If the solenoid switch becomes defective, it must be replaced.

When mounting the switch, use only button head screws. Screws with longer threads would damage the paneling in the passenger compartment.

SIGNAL LIGHTS

The steering column switch (direction indicator switch) is mounted on the left-hand side of the steering column, between the steering wheel and the instrument panel.

It is manually operated by the lever and has three positions:

1. up = right indicator,
2. center = normal position,
3. down = left indicator.

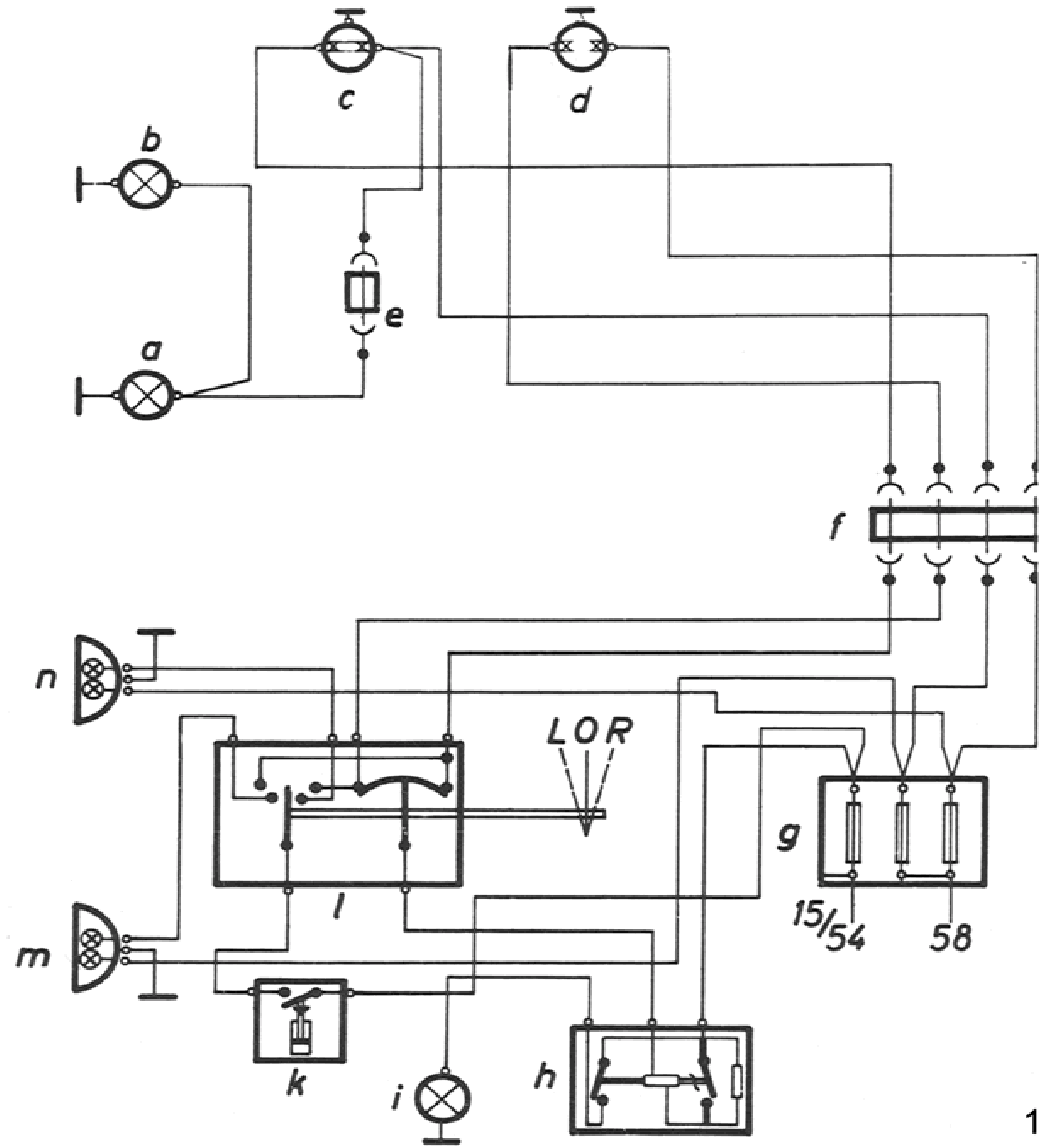
The switch returns automatically to its normal position by means of a cam attached to the steering column. When the steering wheel is returned to the straight-ahead position, the cam trips over and the indicator returns to normal position.

To remove the switch, loosen the two securing screws of the two halves of the housing (Fig.3).

To reach the cable connections, remove the two securing screws (Fig. 4) and the switch knob.

To re-assemble reverse order.

NOTE: Make sure that the cables are properly placed in the recess of the casing. The arresting pin of the casing must be properly introduced into the boring of the steering column (Fig. 5).



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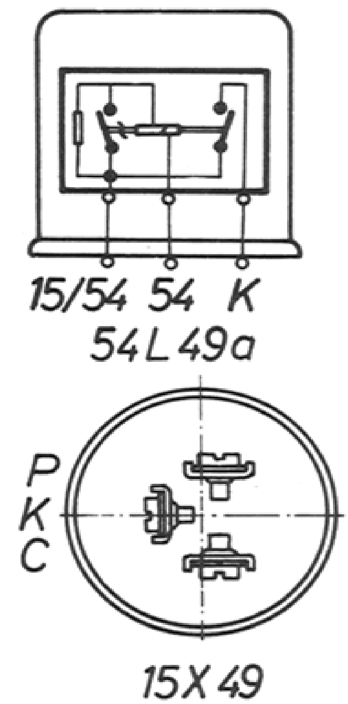

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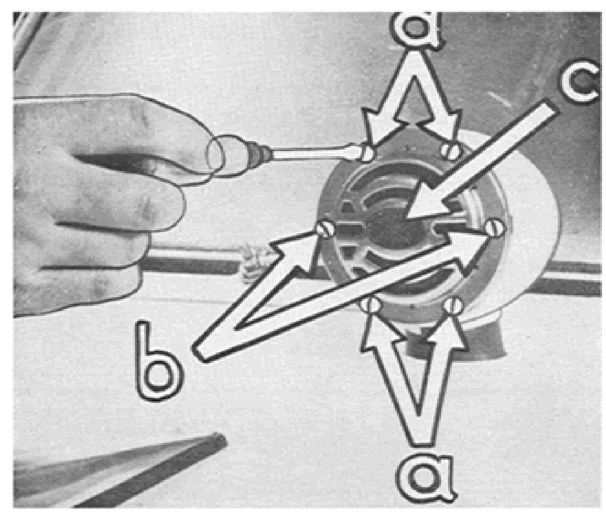

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The switch separates or completes, respectively/ the circuits of the stop and signal lights.

When the switch is in its normal position, the two stop lights are connected with the stop light switch. Thus, in this position, both stop lights light up when the brakes are applied.

When the direction indicator is switched on, the stop light on the indicated side will act as signal light. When braking, the oppositely situated light will act as stop light.

The cable connections are described in the wiring diagram (Fig. 1).

a & b	License plate lights.
c & d	Combined tail and stop light.
e & f	Cable connector rail.
g	Fuse.
h	Flasher unit.
i	Direction indicator control light.
k	Stop light switch.
l	Direction indicator switch.
m & n	Direction indicator lights.

The flasher unit is mounted in the trunk on the wiper motor support bracket.

It is a hot-wire flasher unit with 90 +/- 30 impulses per minute and a load of 2 X 32 cp.

The flasher unit must be mounted so that the connecting clamps point downwards.

Pressure and jolting of the flasher unit are to be avoided as it would tend to affect its functioning.

The method of operation and the cable connections are described in fig.2.

The lights and control-lights are described under heading "lighting".

POSSIBLE DISORDER IN THE FLASHER DEVICE

May manifest themselves in the following manner:

The flashing rhythm is not according to the standard set.

The control light does not register.

The relation between light and dark is uneven, or the signals break down completely.

Such disorders are very often caused by other electric components than the flasher unit. They may be caused by lights, switches or fuses.

The most frequent causes of such disorders are:

Insufficient contact pressure of the bulbs/ the switch or the fuse; corrosion phenomena, and thus causing too high a contact resistance; use of wrong bulbs; short circuits due to brittle or damaged circuits.

A short circuit may cause a defect in the flasher unit without the safety fuse being blown.

SIGNAL-HORN

The horn with holder is mounted on the reinforcement of the trunk lid. To dismantle the horn, loosen the bolt, the two connections and the air vent tube (at the fuel tank cap).

Remove the horn from the hood.

Remove the four mounting screws (Fig.30). (The remaining two screws must not be loosened, as it would change the setting of the horn); Remove horn from the horn body;

Remove the spring package and the small air vent pipe.

Re-assemble in reverse order.

The current-carrying cable runs from the ignition switch over the fuse to the horn.

When the signal-knob is actuated, the circuit is completed against the earth.

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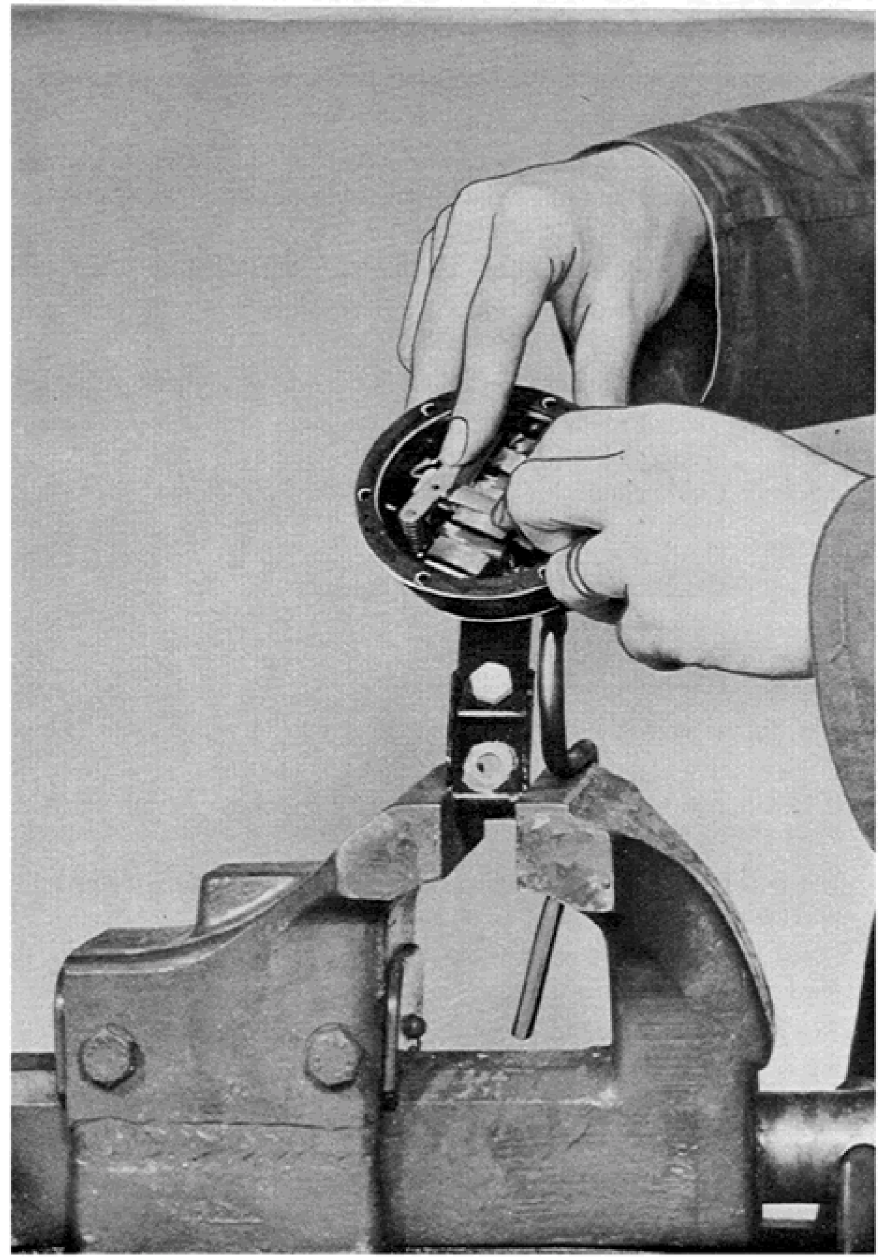

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POSSIBLE DISORDERS IN THE SIGNALING EQUIPMENT

These are characterized by insufficient volume of sound of the horn, or by the total absence of sound.

Disorders may be caused by the following:

defective or damaged horn;

interruption of the plus or minus cable;

defective signal-knob;

bent or broken membrane;

damaged or oxidized contacts;

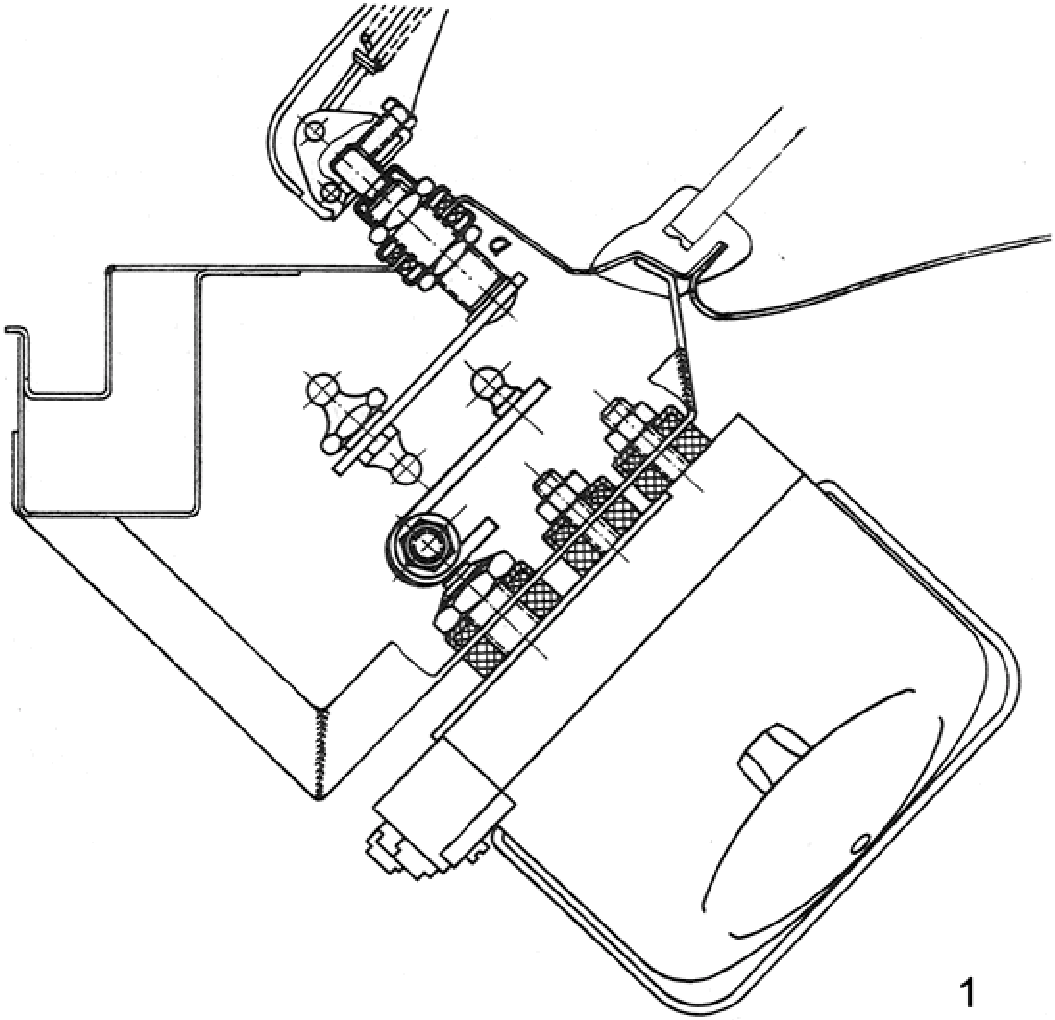
interterm short-circuit of the horn coil or loose coil ends.

The repair of the horn is recommended only in cases of contact-faults. The horn is then disassembled as follows:

Loosen screws (Page 10/26 - Fig. 3b).

Clean contacts with a contact-file (Fig.2) and adjust after the membrane has been re-mounted (Fig. 1).

If the described adjustment does not result in a faultless tone, a correction of the member-armature is to be effected by turning the screw (Page 10/26 - Fig. 3c).



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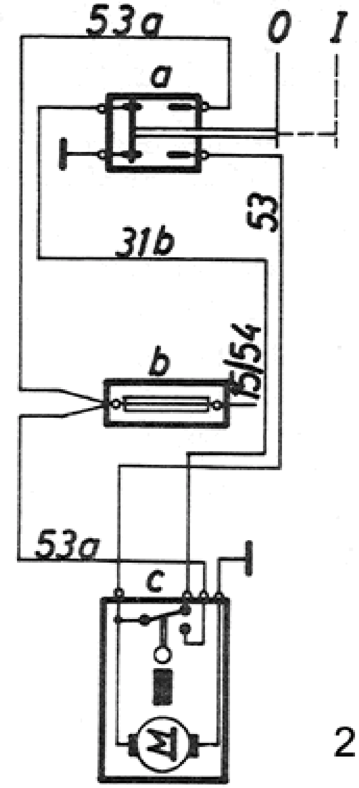

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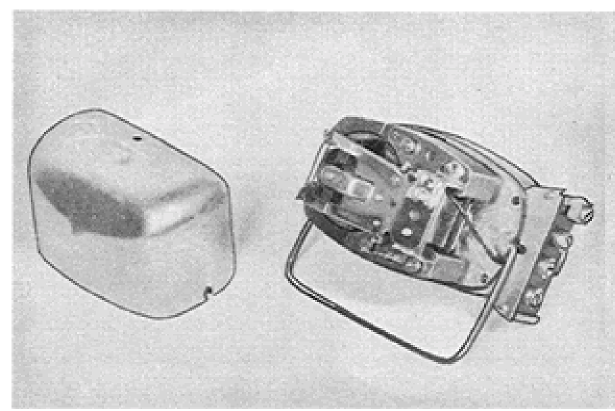

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WINDSHIELD WIPERS

1. Wiper motor

The wiper motor is accessible from the trunk and is mounted behind the gas tank. It is an electric motor with a power input rate of about 24 watts and a slow-run speed of the crank arm of 60 = 4 revolutions per minute. The motor is equipped with a permanent magnet for field excitation and overhung armature.

Maximum torque:	60 cmkg
Wiping periods:	60 per minute at a torque of 7 cmkg

The gear unit, mounted in the crankcase, is driven by the armature whose shaft is finished, on one side, as a gear wheel.

The gear unit has an intermediate gear wheel and a main wheel which is pressed on to the drive shaft of the crank arm. It is a gear unit with a rotating drive shaft. The wiper motor is mounted with three mounting screws and rubber washers on the special support bracket on the body (Fig. 1).

DISMANTLING THE WIPER MOTOR

To dismantle the wiper motor:

Dismantle pivot clamp.

Loosen mounting nut.

Loosen two mounting nuts.

Remove supporting washers and rubber washers.

Lift wiper motor off support bracket.

Disconnect electrical cable.

Remove wiper motor.

To clean the armature and to check the carbon brushes, the holding clamp and the lid must be dismantled (Fig. 3). If these parts are found worn, the wiper motor must be replaced.

Assembly is in reverse order. The mounting nuts of the wiper motor must not be tightened excessively, as the rubber washers, serving as vibration dampers, would be crushed.

After mounting, check if the motor runs freely. The pivot clamp must be adjusted so that it rotates freely.

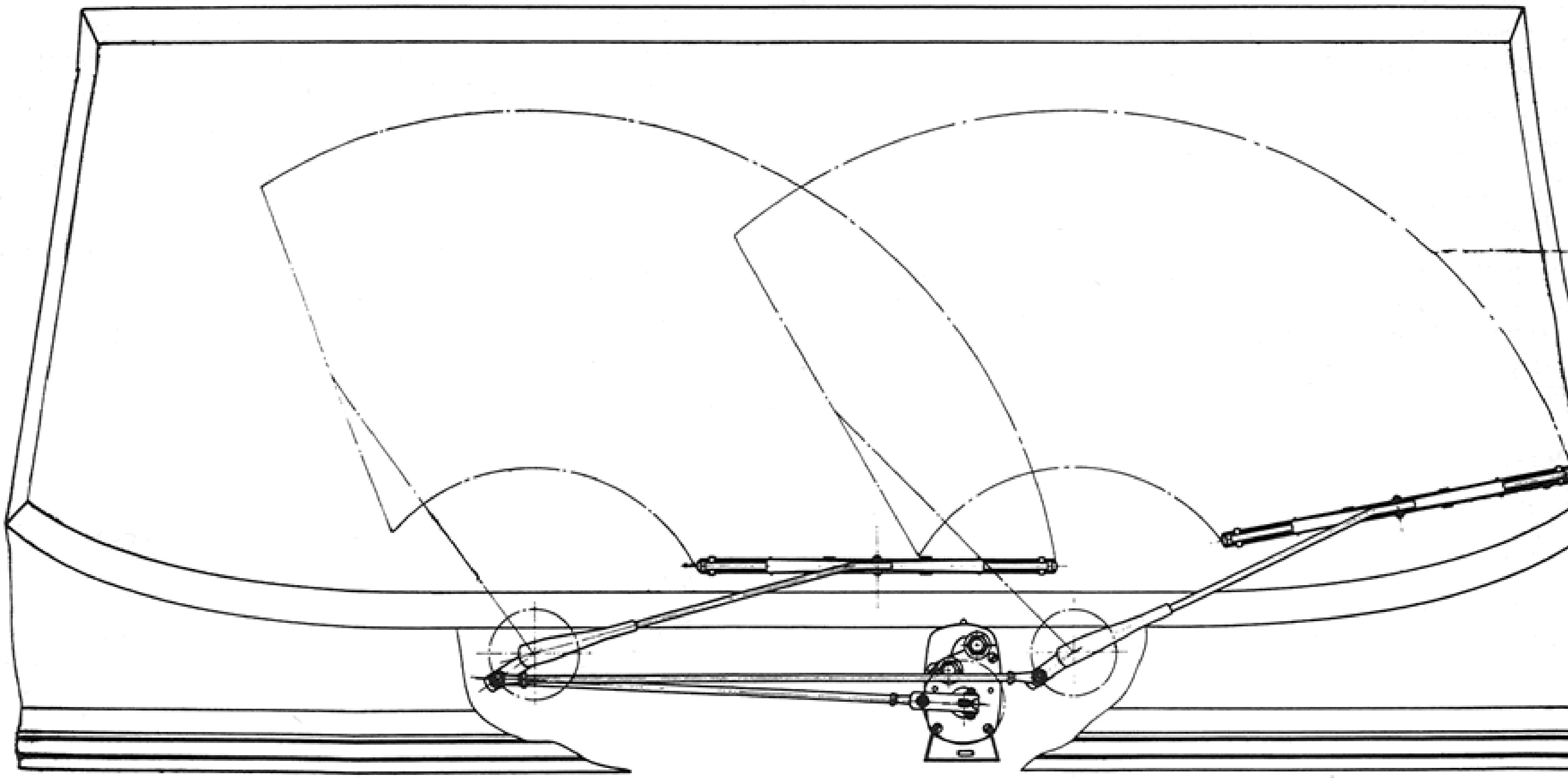
Fig.2 shows the electrical layout of the wiper motor:

a. Wiper motor switch.
b. Fuse.
c. Wiper motor.

LINK RODS, WIPER PIVOT, WIPER ARMS AND WIPER BLADES

Description:

The link rods and gears, transform the rotary motion of the electric motor into a thrust motion at the wiper pivot or at the wiper arm.



The rotating pivot clamp is mounted on the shaft of the wiper motor by means of a clamping bolt. The pivot clamp, through the link rod, drives the left wiper pivot which is mounted on the body. The link rod transfers the motions of the left wiper pivot to the right one. The rods are adjusted to the exact lengths at the factory. The length can be changed only if the lock nuts of the links are loosened and, in the case of bent rods, only after the latter have been straightened. If the link is worn or found defective, the entire link rod must be replaced.

The two wiper pivots mounted on the body are inserted into the guide pin on the body through the trunk. (Page 10/30 - Fig. 1a.)

A rubber sealing washer with a ring-mounted support washer under the mounting nut prevents water from seeping into the trunk. A plastic cap is fitted on the wiper pivot shaft to prevent water and dirt from getting into wiper pivot. The right wiper pivot differs from the left one by the different length of the pivot arms. Two ball ends are mounted into the left, for the insertion of the pivot and link rods. A screw in the clamping leaf serves for the mounting of the wiper arms on the wiper pivot.

When assembling the wiper blade and the wiper arm, make certain that the wiper blade does not hit the weatherstrip of the windshield and that the holding clamps of the wiper blade do not scratch the windshield (if the clamping rod is bent).

DISMANTLING OF WIPER PIVOT

Loosen the link rods at the wiper pivot (through the trunk).

Dismantle wiper arms.

Remove plastic cap.

Remove mounting nut.

Remove support washer and sealing rubber washer. Remove wiper pivot through the trunk.

When assembling, make sure that the wiper pivot shaft moves easily, is well greased, and that the sealing rubber washers fit tightly.

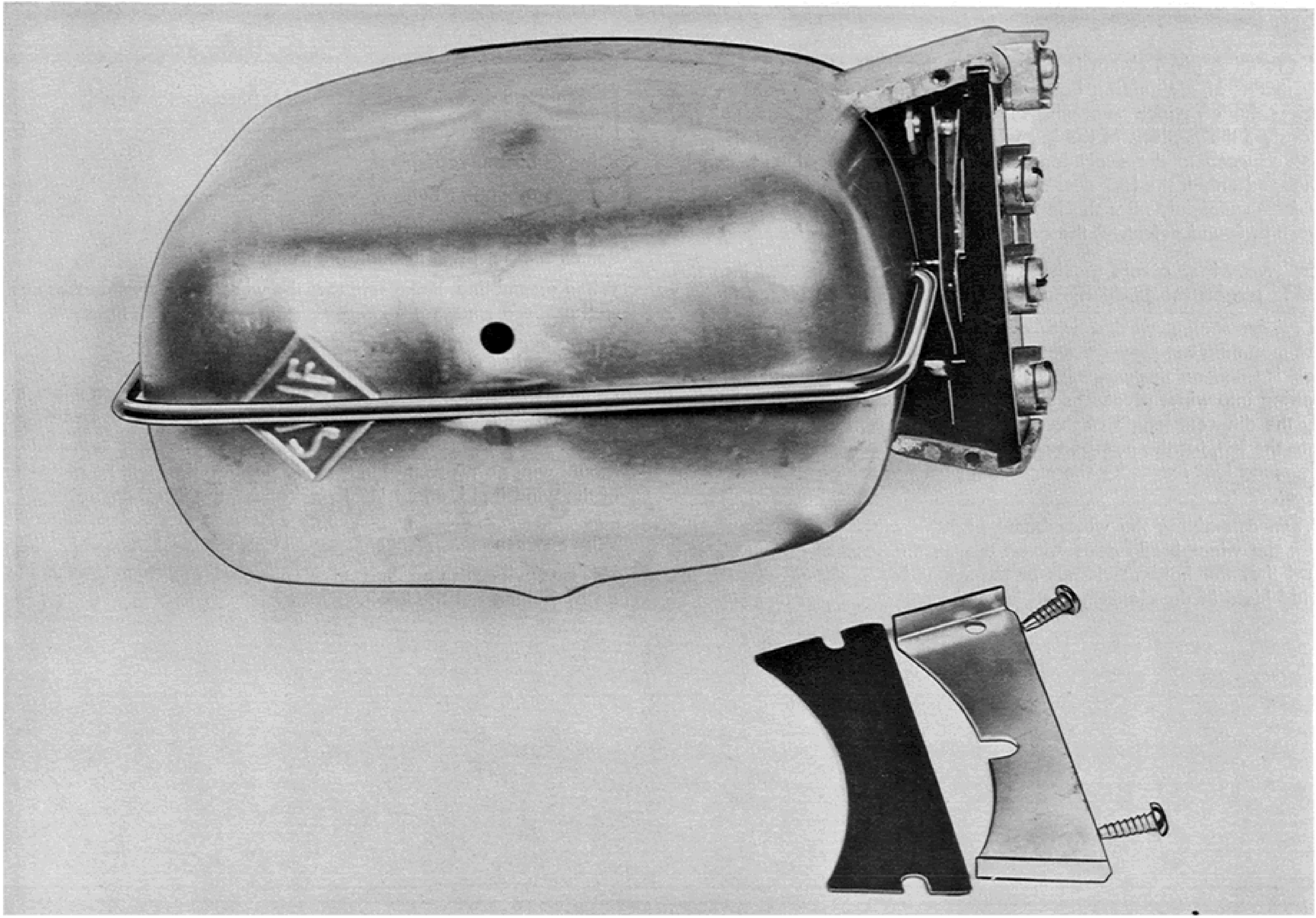
ADJUSTMENT OF WIPER ARMS

After assembling the wiper pivot and the rods, switch on wiper motor; check functioning and quiet running of the equipment and determine final position.

Mount wiper arms so that in the idle position they will lie at the bottom of the windshield, about ¼" to ½" above the weatherstrip.

WIPER SWITCH

This is a pull switch on the instrument panel, and the wipers are turned on by pulling out the knob.



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DISMANTLING OF THE SWITCH

Dismantle switch knob and ring nut on instrument panel.

Through trunk remove switch and disconnect electrical circuits.

When assembling, make certain that the crossbar connects the electric clamp 53 or 54, when the switch knob is pulled out. (Or, conversely, that clamp 31 connects when the switch knob is pushed in.)

BREAKDOWNS

Operating trouble with the wiper equipment may be caused by the following:

a. Noisy running of the motor:

   Improper assembly
   Missing rubber washers (vibration dampers)

b. Defective motor

   Worn out carbon brushes
   Burned-out armature

c. Faulty wiper motor gearing

   Defective plastic intermediate gear wheel
   Trouble caused by wrongly assembled linkage or by stuck wiper pivot

d. The motor does not automatically switch off final position

   Switch-off contacts of the wiper motor are dirty or bent.

REMEDY:

Remove motor, dismantle cover plate over the contacts (2 screws) Fig. 1). Turn motor by hand and check whether contacts close faultlessly; if necessary, adjust by bending the contact spring. Check release cams of the contacts.

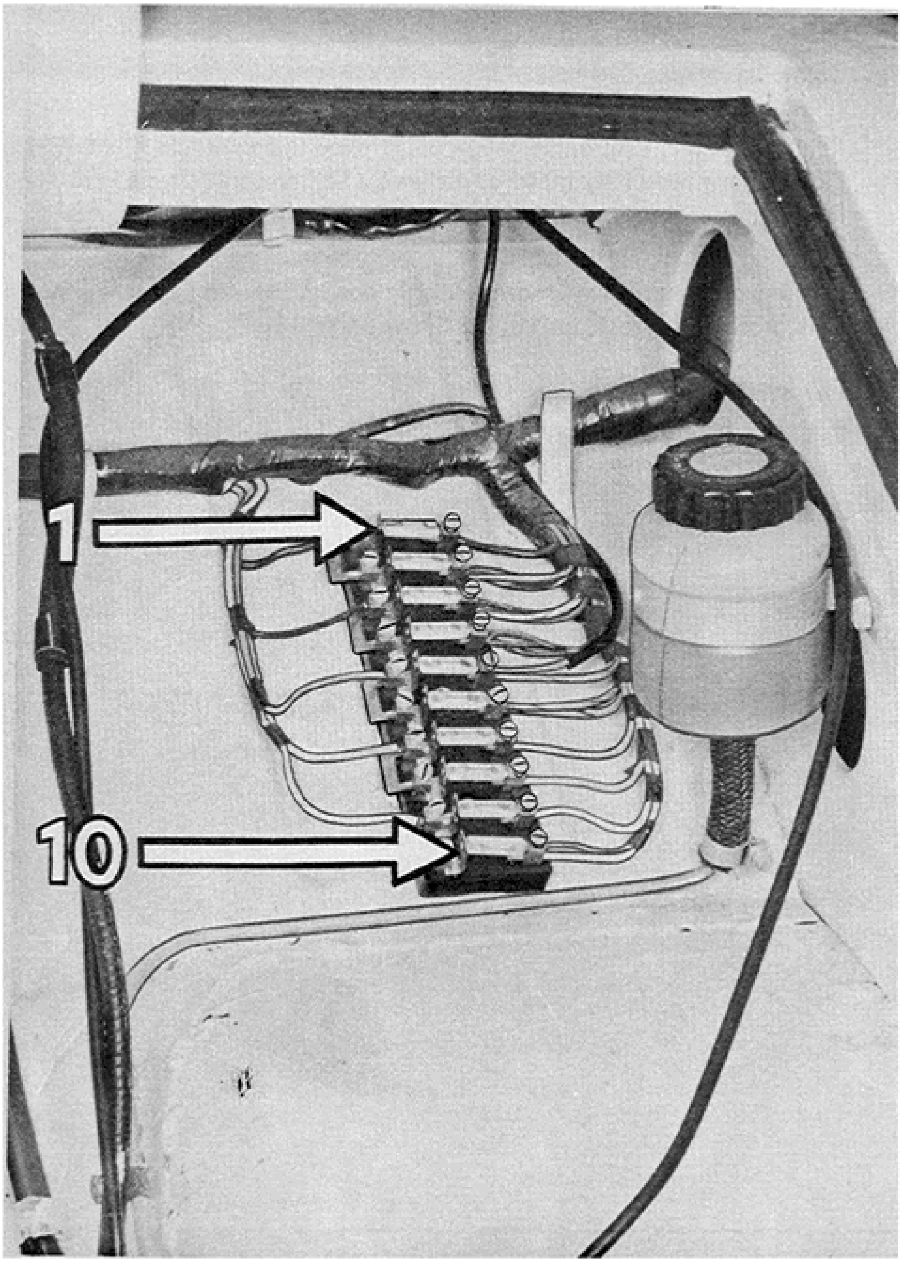
If wiper motor and switch are wrongly connected, the motor will not switch off at the rest position of the wipers.

HEATER SYSTEM

The electrical system of the heater is described in group 9.

BILGE PUMP

The bilge pump and the electrical system is described in group 12.



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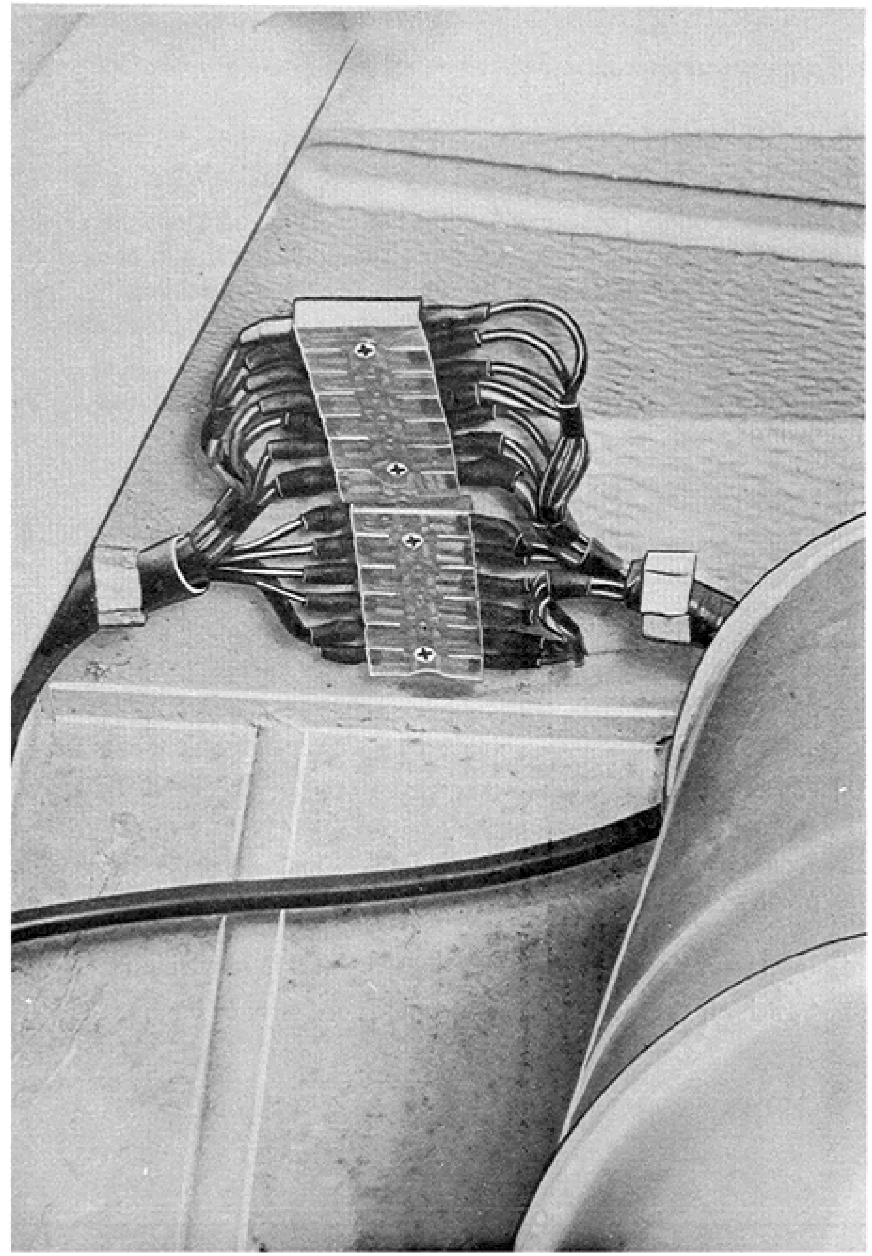

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FUSE BOX

(Fig. 1)

The fuse box is located in the luggage compartment. It is important to find out the cause of the blown fus8 and to repair it before another fuse is replaced. The following electrical parts are protected by 8 amp. fuse:

	In	Out
1.	Ignition switch (30)	Bilge pump
2.	Ignition switch (30)	Horn, cigarette lighter, position lights red/green. Top control light (Interior light, electric clock)
3.	Ignition switch (15/54)	Indicator & stop taillight, heater
4.	Ignition switch (15/54)	Windshield wiper motor and switch, back-up lights
5.	Light switch (58)	Tail light right, parking light right, dash board light
6.	Light switch (58)	Tail light left, parking light left, license plate lights
7.	Dimmer switch (56 B)	Dim light right
8.	Dimmer switch (56 B)	Dim light left
9.	Dimmer switch (56 A)	High-beam light right
10.	Dimmer switch (56 A)	High-beam light leftHigh-beam control light

NOTE: In the first production series there are the following deviations from the chart:

Fuse 1: Position light red/green, Top control light

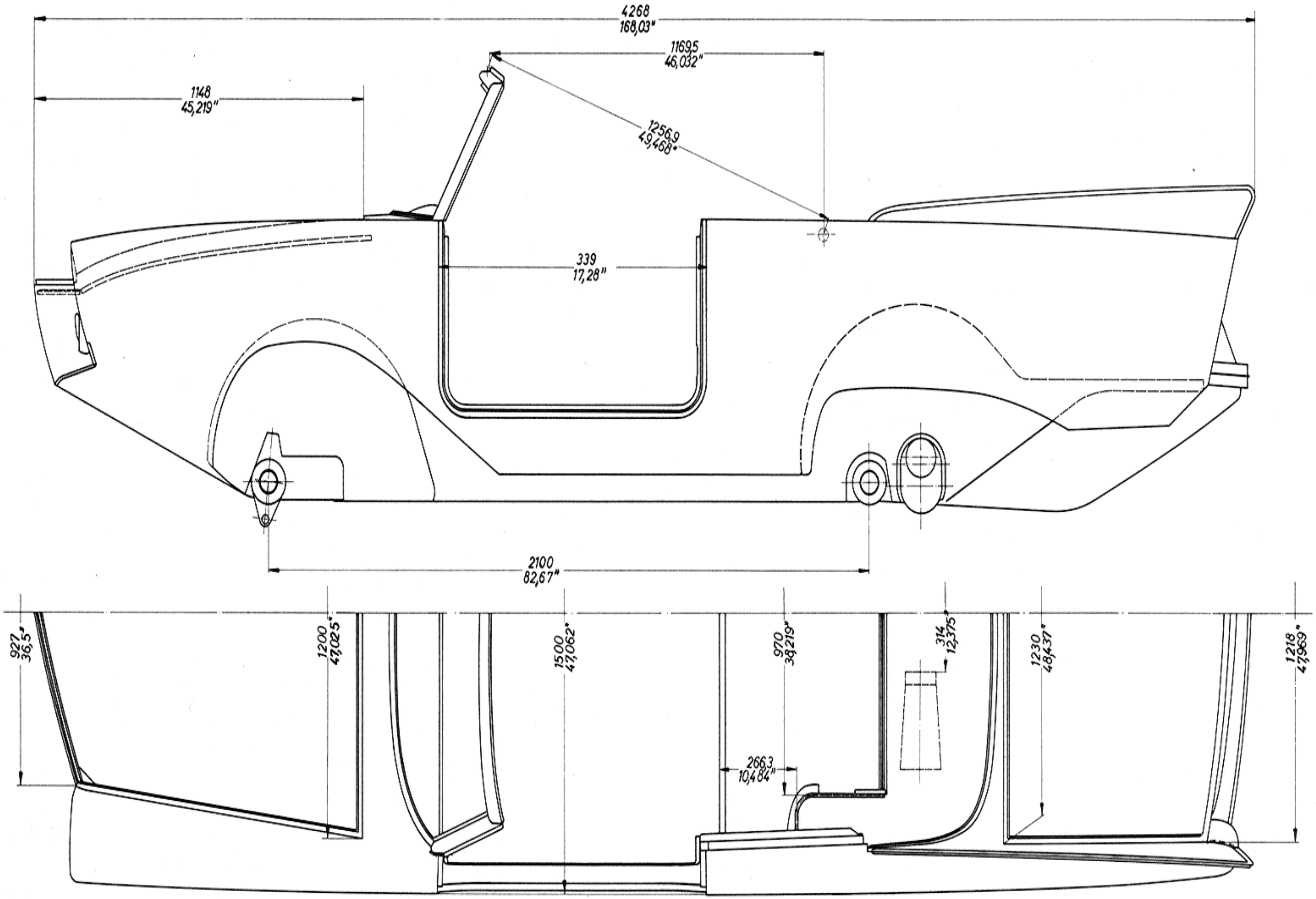
Fuse 2: Horn, Back-up lights

CABLE SETS:

Consists of the following cables:

1.	Cable assembly I	leads from the instrument switches, through the fuse box, the head lights, parking lights, directional lights, position lights and dimmer switch to the rail connector located in the left side of the engine compartment.
2.	Cable assembly II	leads from the rail connector to both tail lights, top control light, license plate light, back-up lights, generator, thermo-stat, bilge pump and oil pressure switch.
3.	Cable assembly III	is located behind the instrument panel.
4.	Cable for engine lid	
5.	Starter cable, battery cable, earth strap of battery, earth strap connected to transmission, ignition	

NOTE: The rail connectors (6 and 7 poles) (Fig. 2) which connect the cable assembly I and cable assembly II are fastened by 4 sheet metal screws to the engine compartment partition wall. Fiber washers must be used when fastening these screws in order to avoid a shortcircuit.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339
17,28"
2100
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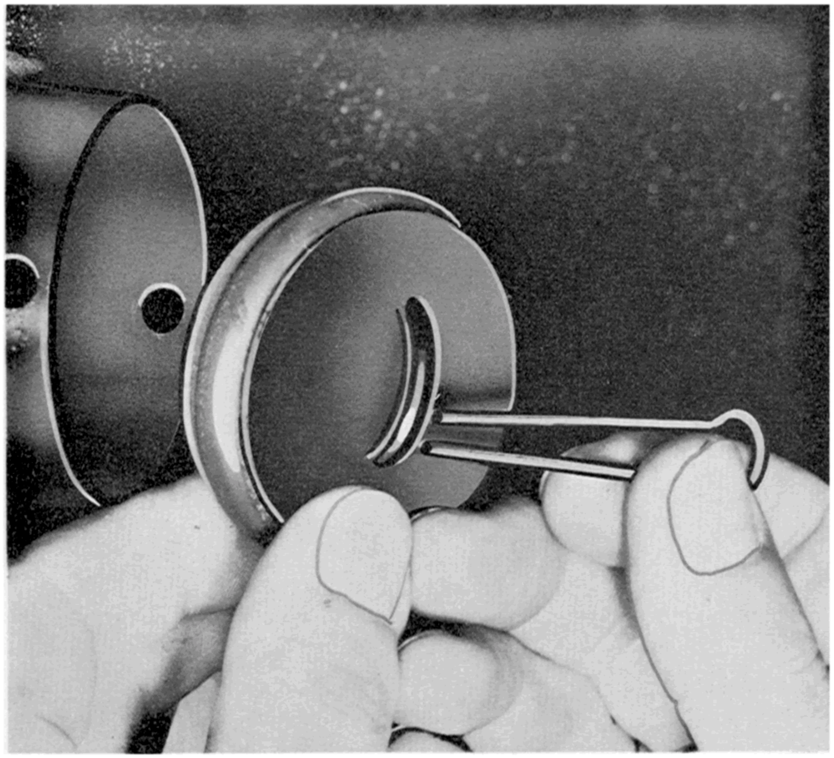
36,5"
1200
47,025"
1500
47,062"
970
38,219"
314
12,375"
1230
48,437"
1218
47,969"
266,3
10,484"



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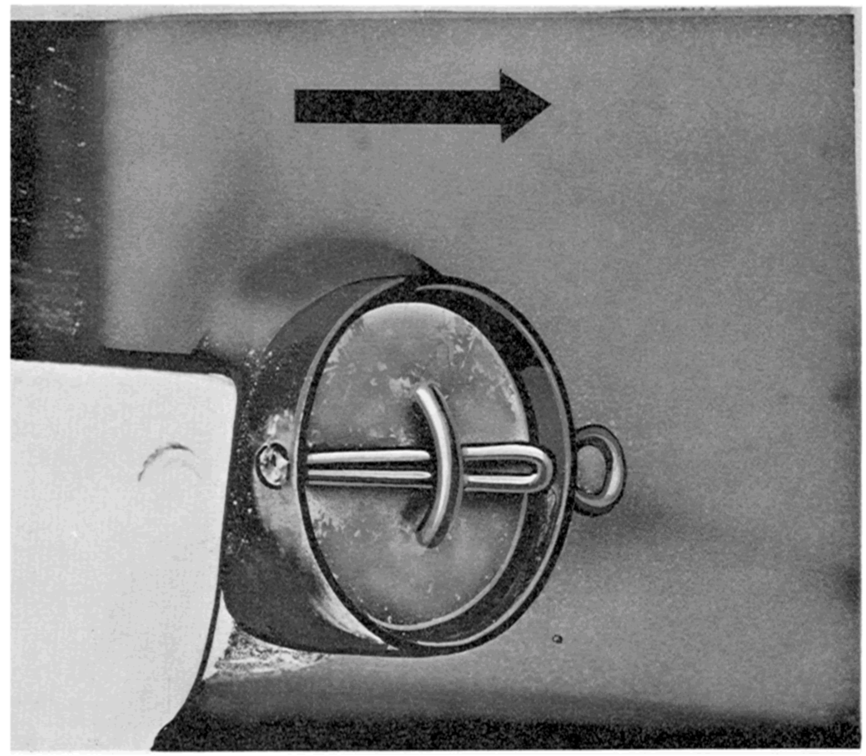

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BODY AND CHASSIS, CONTROL LINKAGES

BODY

Construction: The Amphicar model 770, is a two door, four seat convertible having the engine rear mounted. The luggage trunk is mounted in the front of the vehicle with additional luggage accommodation being provided behind the rear seat backrest.

The self supporting, all steel body/hull is continuously arc welded at the seams for maximum strength and water tightness. Since the lower portion of each door is below water level a warp free body is essential, therefore, the body/hull shell is constructed over a welded double square tube frame of exceptional rigidity.

Water is prevented from entering the engine compartment through the louvers in the engine cover by the high rear fender fins which curve slightly outwards thereby forcing any side wash down and away from the car.

Access to the steering arms is obtained through a removable plate bolted to the underside of the hull at the front of the vehicle.

The steel used throughout the construction of the body is of considerably heavier gauge than normally used in automobile manufacturing. Gauge of steel is as follows:

Hull bottom	=	.049"
Wheel arches	=	.039"
Side panels	=	.028"

A drain plug is situated at the lowest point of the hull bottom to facilitate flushing and draining the bilge during servicing. With the drain plug removed, assess is also provided to the crankcase oil drain plug.

BODY REPAIRS

When it is necessary to repair the body utilizing welding equipment only arc welding must be employed.

Gas welding must not be used under any circumstances since this may deform the metal resulting in lack of water tightness at joints and seams. Restoration of original shape and rigidity is a vital part of body repairs to ensure such water tightness.

WINDSHIELD

The curved windshield is sealed in the windshield frame by a rubber weatherstrip.

Installation of the windshield is effected in the following manner:
Clean windshield frame.

Place weatherstrip over windshield.

Place a cord in the outer groove of the rubber weatherstrip with the ends meeting at the bottom center of the windshield.

Insert the windshield glass and weatherstrip into the bottom of the windshield frame from the outside and press down so that the rubber weatherstrip is a snug fit.

From the passenger compartment, pull the two ends of the cord which will cause the inner lip of the weatherstrip to slide over the windshield frame all around.

After the windshield and rubber weatherstrip are in place, inject a rubber sealing compound between the outer lip of the weatherstrip and the windshield frame.

Clean off excess sealing compound.

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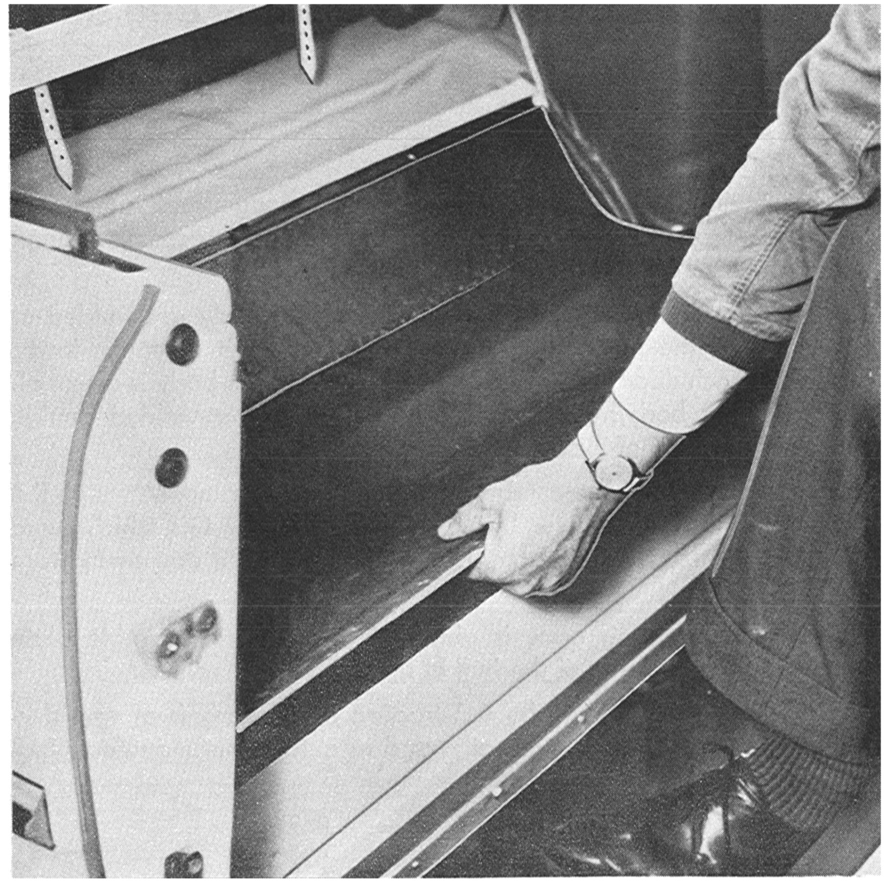

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SEAT BASE

To dismantle the seat base it is necessary to remove the rear seat and backrest and to remove the retaining screws of the seat base. The front retaining screws are covered, at the seat support, by a rubber strip.

The seat base is lifted over the front seat support and is pulled out toward the front.

BUMPERS

The front bumper is fastened to the body by means of two brackets. For the purpose of water tightness, a rubber seal is inserted between the brackets and the body. The retaining screws are equipped with dubo nut locks (bolt locking plates).

A divided bumper arrangement is built into the vehicles beginning with

Serial No. 101 188 (White and blue vehicles)
and Serial No. 101 765 (Red and green vehicles), resp.

Both rear bumpers must also be installed with rubber seals and dubo nut locks (bolt locking plates) for the purpose of water tightness.

The **towing hook** is fastened in the front, under the floor base. It is essential that the rubber seal fits tightly. The gap between the front chassis cross member and the hull bottom must be compensated with distance pieces.

DOORS

The door windows can be fully lowered. Absolute water tightness of the doors is obtained by using two mating rubber seals, one on the door frame and one on the door itself.

In addition to the regular door lock, there is a second tongue lock which is applied during water use. This lock compresses the two rubber door seals. This second lock is also a safety feature preventing inadvertent opening of the door when the vehicle is in the water.

The doors, which are rear opening, are attached to the door frame by two hinges each.

Remove the doors as follows:

Remove blind nut, handle and washers from the door safety lock.

Remove Phillips head screw, handle, ferrule and spring from the regular door lock.

Push back chrome distance piece and remove tapered lock pin.

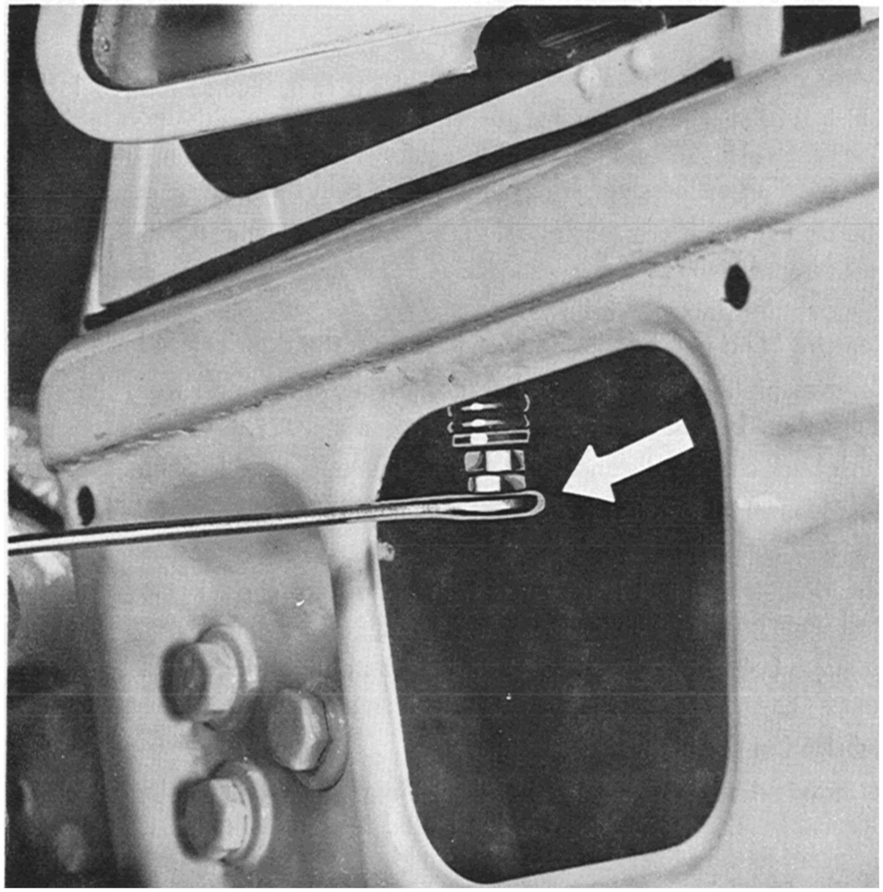
Remove retaining screw from window winding handle and slide handle off shaft .

The door trim panel is fastened with upholstery clips. Remove panel and door and pry outwards.

Remove bolts from door hinges and door stoplight and door.

LUBRICATING THE HINGES

Remove rubber plug from top of door hinge post. The top hinge is now accessible. The lower hinge is lubricated by removing the trim panel adjacent to the wheel arches. This panel is attached in the same manner as the door trim panel.



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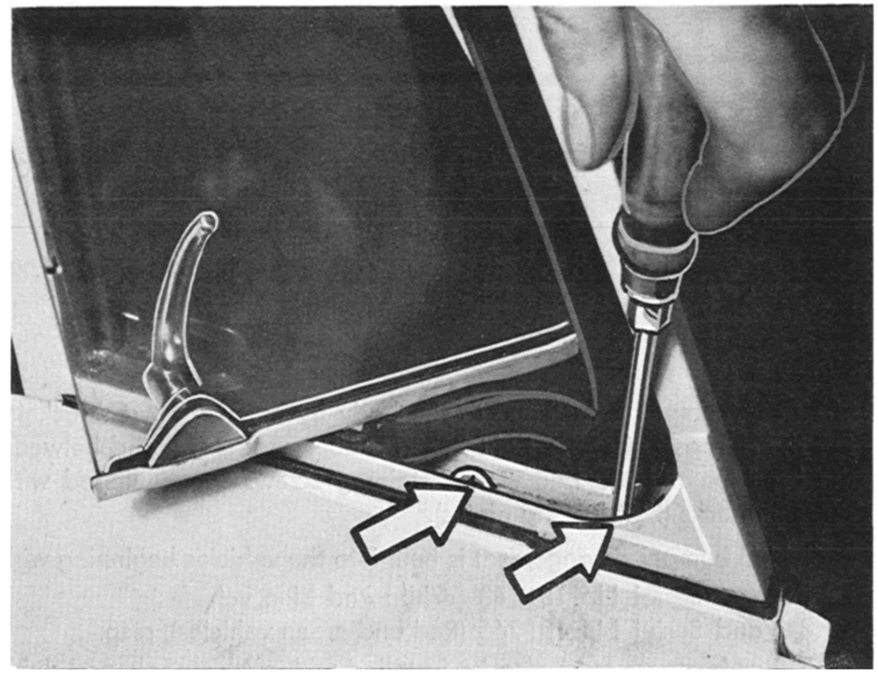

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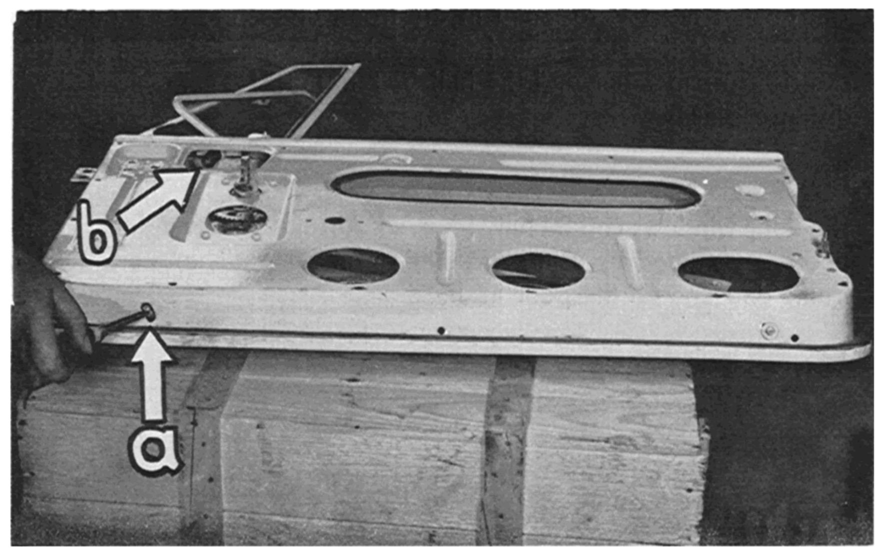

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RUBBER SEALS

The rubber sealing strips on doors, door frames, trunk opening, and engine cover openings are attached with an adhesive and are each in one continuous strip. It is essential that only genuine factory seals are used for replacement since they must have a specific rate of compression to ensure a perfect water tight seal.

The following procedure is to be closely followed when replacing rubber seals:

Remove old seal and thoroughly clean area.

Rub benzene on new seal and let dry thoroughly apply a thin layer of special adhesive to one side of the seal and to the mating surface on the appropriate body panel. Allow both glued surfaces to become tacky before fitting new seal. Do not press or squeeze seal out of shape.

Press seal on tightly starting at center and gradually working towards ends. Cut off excess seal making sure that the two ends butt against each other perfectly.

Should anyone part of the seal not adhere tightly, the entire seal must be removed and entire operation, as described above, be repeated.

VENT WINDOWS

To remove, the following procedure is to be adopted.

Remove all door handles and trim panel.

Remove lock nuts and washers from lower pivot pin of vent window frame.

Drill out rivet in upper pivot.

Pull vent window assembly outward and upwards at a slight angle.

Check vent window rubber seal. Replace if necessary.

VENT WINDOW FRAME

Should it be necessary to remove the frame of the vent window the steps detailed in the preceding section must be taken, plus.

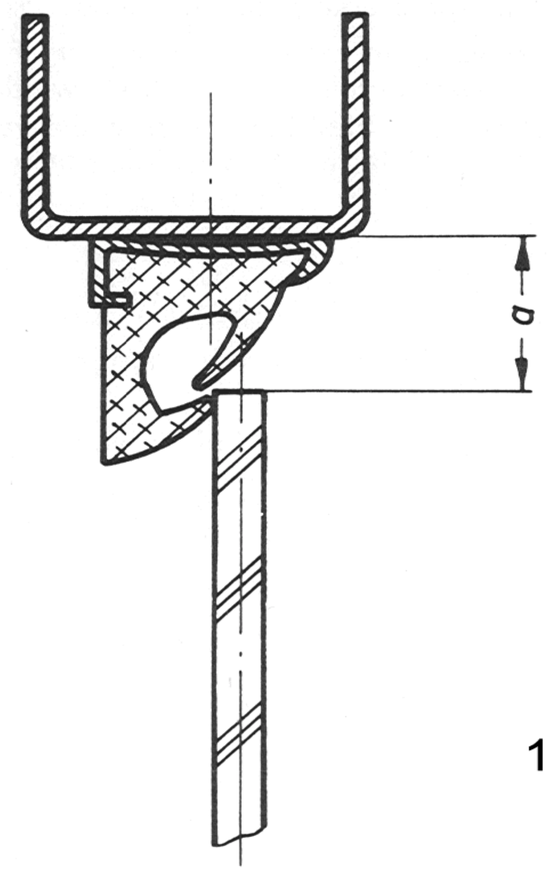
Remove retaining screw in extreme lower part of door and remove three retaining screws situated beneath vent window sealing rubber (Fig. 2). The door window seal is affixed to the vent window frame therefore, this must be detached before lifting out entire frame assembly.

REPLACING DOOR WINDOW SEALS

Remove defective seals and clean channels thoroughly.

Insert new seals into window channels using same method as detailed under section headed rubber seals.

After installation check that the window winds up and down freely (Fig. 3 a + b).



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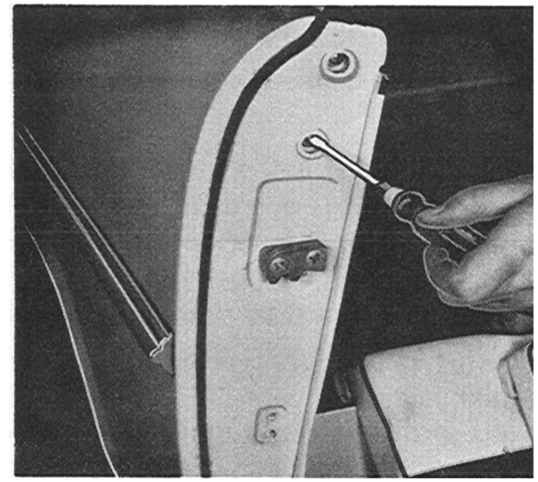

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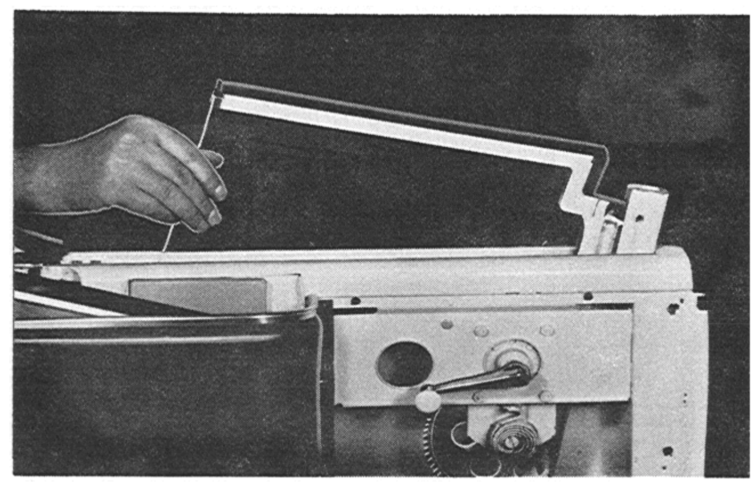

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WINDOW REGULATOR AND GLASS

Dismantle as follows:

Remove door handles, window winding handle and trim panel.

Remove the four round head screws (Fig. 2) from window regulator.

Position window regulator to the most favorable position.

Remove window from its retaining channel and pull window regulator out of door.

To remove the window glass itself merely slide up and out through the opening in the top of the door.

The height limiting stop is adjustable and is mounted on to an inner structural member of the door.

It is, therefore, possible to adjust either up or down the maximum height of the door window when in its full up position. The distance between the top of the window glass and the frame of the convertible top (with rubber weatherstrip removed) should be 11/16 inch.

Window regulators and glass channels should be lubricated with lubriplate or equivalent to ensure smooth operation.

DOOR LOCKS

Remove inside door handles and trim panel. The door lock can be removed after taking out the retaining bolt of the rear glass channel.

Adjustment of the door lock is obtained by slackening two striker plate securing screws and sliding striker plate backwards or forwards.

DOOR SAFETY LOCKS

Remove inside door handles and trim panel.

Unscrew three safety lock securing screws. Remove lock.

The safety lock striker plate is adjusted in the same manner as the normal door lock striker plate, except that it is adjusted at an angle.

OUTSIDE DOOR HANDLES

Remove inside door handles and trim panel.

Take out round head screw from outside door handle and remove handle by pulling up and forward.

When reassembling, make sure that the rubber seal between the handle and door panel is correctly positioned and is flat against door. The driver's door is locked from outside with a key. The passenger door is locked by the interior door handle.

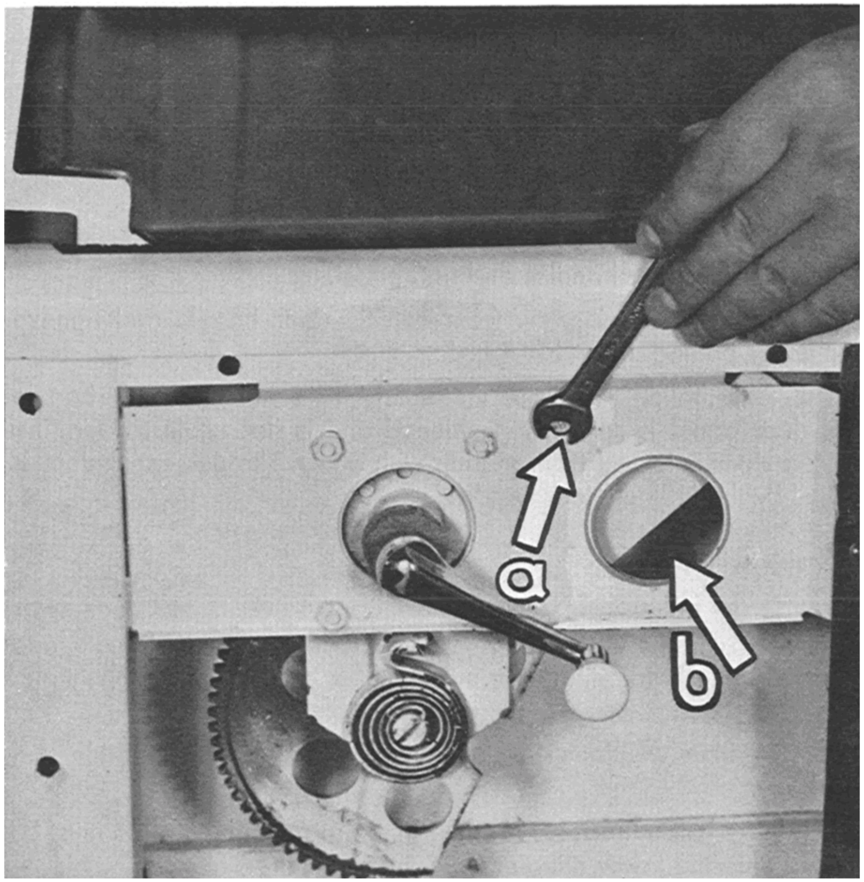
REAR SIDE WINDOW

Dismantle as follows:

Push back chrome distance piece on window winding handle and remove tapered lock pin. Remove two rubber plugs from door post and take out the two screws that then become accessible.

Remove rubber weatherstrip and pull window upwards until clear of the body.

When there is too much slack in the hinge, a new hinge plate must be riveted onto the lower edge of the front channel.



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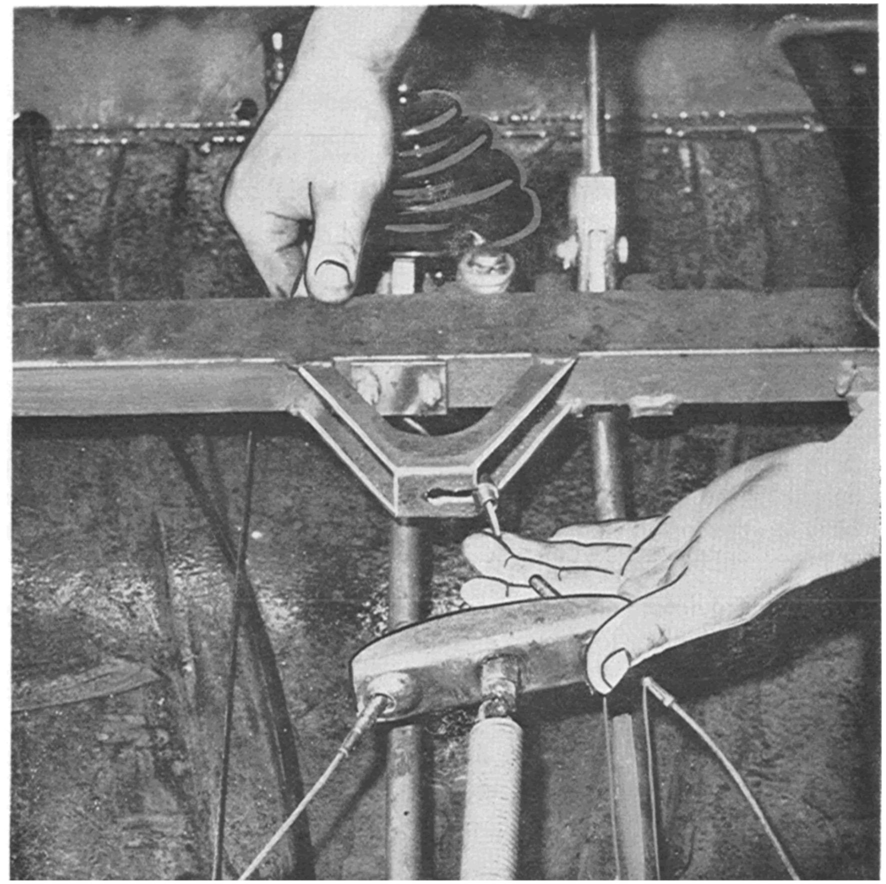

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DISMANTLING REAR WINDOW REGULATOR

Remove rear window. Remove the four window regulator nuts and take out regulator. When reassembling, adjust height of glass to level of door window by means of the two slotted holes in the hinge bracket and also adjust window regulator stop so that rear window lines up vertically with door window.

TRUNK LID

The trunk lid is fastened to the front scuttle panel with two hinges. The four bolt holes in each hinge are elongated to provide adjustment. The trunk lid safety catch is situated at the front of the lid on a mounting bracket. The trunk lid is locked by means of two tongue locks, one on each side at the front of the trunk lid. They are operated by the square key. When locking the trunk the tongue locks pull the trunk lid down tightly against the rubber seals — ensuring a water tight fit. The tongue locks are adjustable to achieve perfect sealing. The tongue locks each have a lock cover which is secured by two Phillips head screws. These covers prevent water from leaking into the locks themselves.

ENGINE COVER (DECK LID)

The deck lid is hinged on the drivers side by two hinges and is locked on the passenger side by a single tongue lock. Adjustment and operation is identical to the trunk lid except that it does not have a safety catch.

HANDBRAKE

The handbrake is located beneath the instrument panel on the right hand side of the steering column. To engage, pullout handle firmly and twist one quarter turn. To disengage twist handle back to horizontal position and release.

The handbrake operates on the two rear wheels by means of Bowden cables. To replace the cable, the front seat, floor mats and floor must be removed.

Take out split pin from handbrake pivot arm and detach cable yoke (Fig. 2).

Dismantle handbrake cable at handbrake by removing bolt and washer from threaded bracket.

Pull cable into inside of car.

Linkage and adjustment is described in brake system. Group 6.

Effective with serial number 103 001 the handbrake system has been improved. Repairs and adjustments on the improved system are carried out in a similar manner.

PEDALS

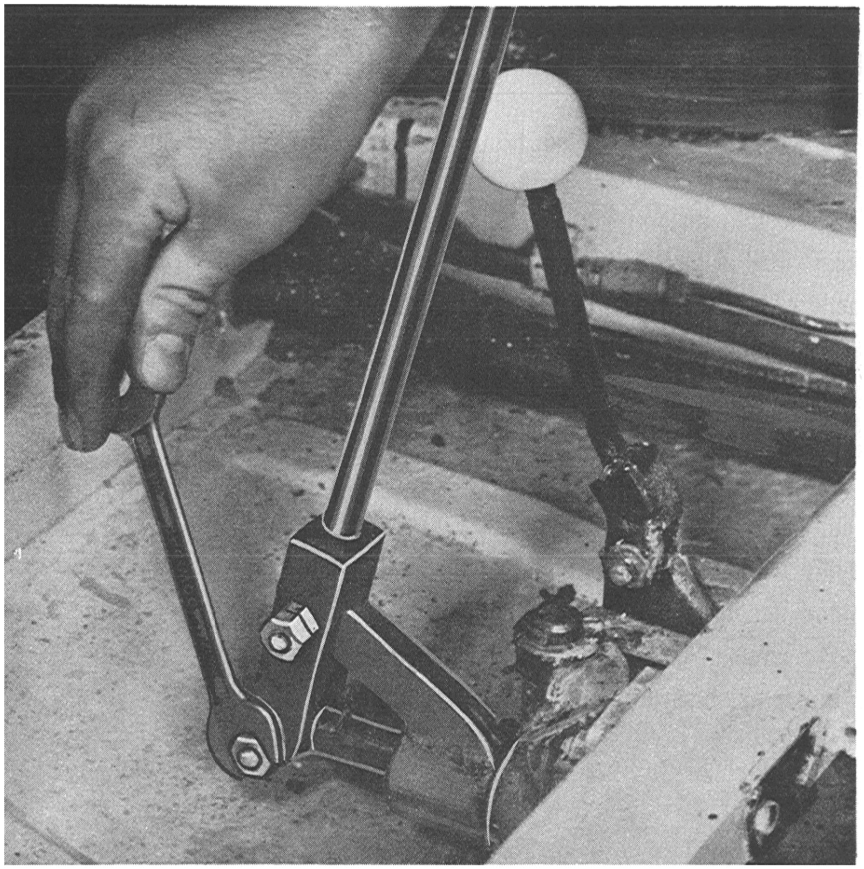
To obtain access to the pedal linkage, the following steps must be taken.

Remove front seat, floor mats and floor.

Remove accelerator pedal link split pin.

Remove screws from foot dimmer switch.

Dismantle toe board (up to chassis 103 000 only).



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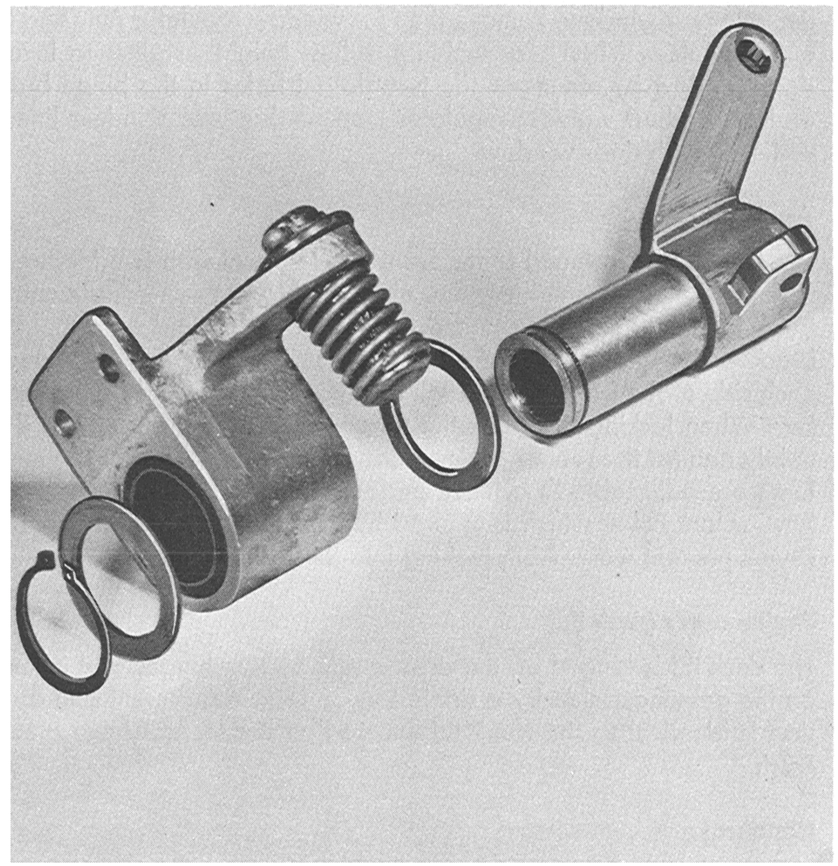

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DISASSEMBLY OF PEDALS AND PEDAL SHAFT

Remove split pin from pedal shaft.

Unhook pedal return springs.

Unbolt pedal shaft lock plate and remove pedal shaft by pulling to right (passenger side).

The nylon pedal shaft bushings must be replaced if worn. Prior to reassembly of original or replacement bushings, lubricate them preferably with Molykote or similar high quality nylon lubricant.

DISASSEMBLY OF CLUTCH BOWDEN CABLE

Remove front and rear seats.

Remove floor mats, floor and rear seat base.

Remove split pin from Bowden cable end fork.

Remove both front and rear nuts! also fork adjustment screw.

Pull Bowden cable out and check, before refitting the cable must be greased.

Refitting the Bowden cable is in the reverse order.

Adjust clutch play (free pedal play should be 5/8 inch.).

DISASSEMBLY OF ACCELERATOR CABLE

Remove front and rear seats.

Remove floor mats, floor and rear seat base.

Remove split pin from accelerator pedal linkage rod.

Remove the cable fasteners.

Disconnect cable at the carburettor linkage, and pull the cable out. Before refitting the cable it should be smeared with grease.

HAND THROTTLE CABLE

The hand throttle cable leads from the left hand side of the instrument panel to the accelerator pedal.

For operation during water use, the accelerator pedal must be depressed and at the same time the operation knob must be pulled out and turned to the desired position.

To replace the throttle cable it is necessary to loosen the clamping nipple (accessible from trunk) and pull the cable out.

To remove the cable cover, the cable clip (two securing screws situated on the front partition) and the knob securing nut on the instrument panel must be loosened.

Prior to reassembly the Bowden cable must be smeared with grease.

GEAR SHIFT MECHANISM

The gear shift mechanism consists of the following:

Gear lever, mounting bracket with shift rod joint, operating shaft, rear bearing, ball seat (female) and ball seat bolt joint.

To dismantle or adjust the gear shift mechanism the front and rear seat, rubber mat, and floor, and rear seat base must be removed.

The gear lever is secured to the shift rod joint and the operating shaft with two hexagon bolts with nut and lock nut (Fig. 1).

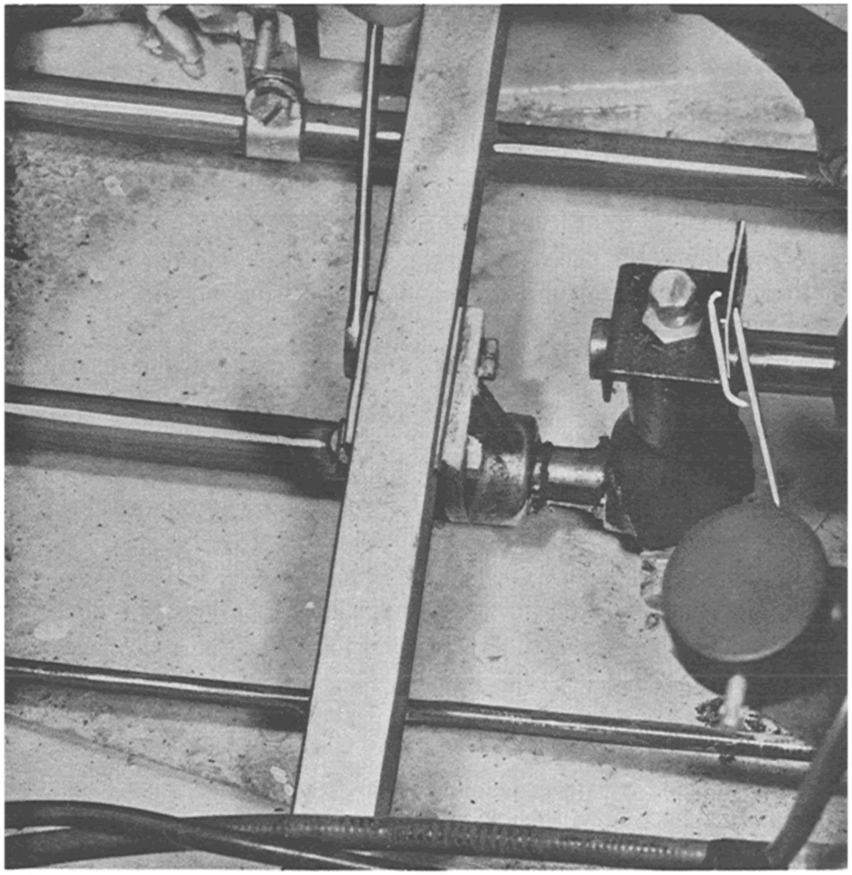
The reverse gear end stop consists of a pressure spring mounted on the shift rod joint pin.

The small tension spring prevents gear lever vibration.

To adjust, remove the split pin from the shift rod joint pin, and place enough distance washers until the gear lever lines up with the first and second gear position when drawn over to the left. (Fig. 2 shows dismantled shift rod joint with bearing.)

When assembling the operating shaft rear bracket the distance of 2-3/4 inches from the center of the operating shaft to the center of the gearbox shift rod must be observed. This is adjustable on the rear bracket elongated holes.

If this adjustment is not exact, the ball head (male) may jump out of the ball seat joint during shifting, or may become blocked.



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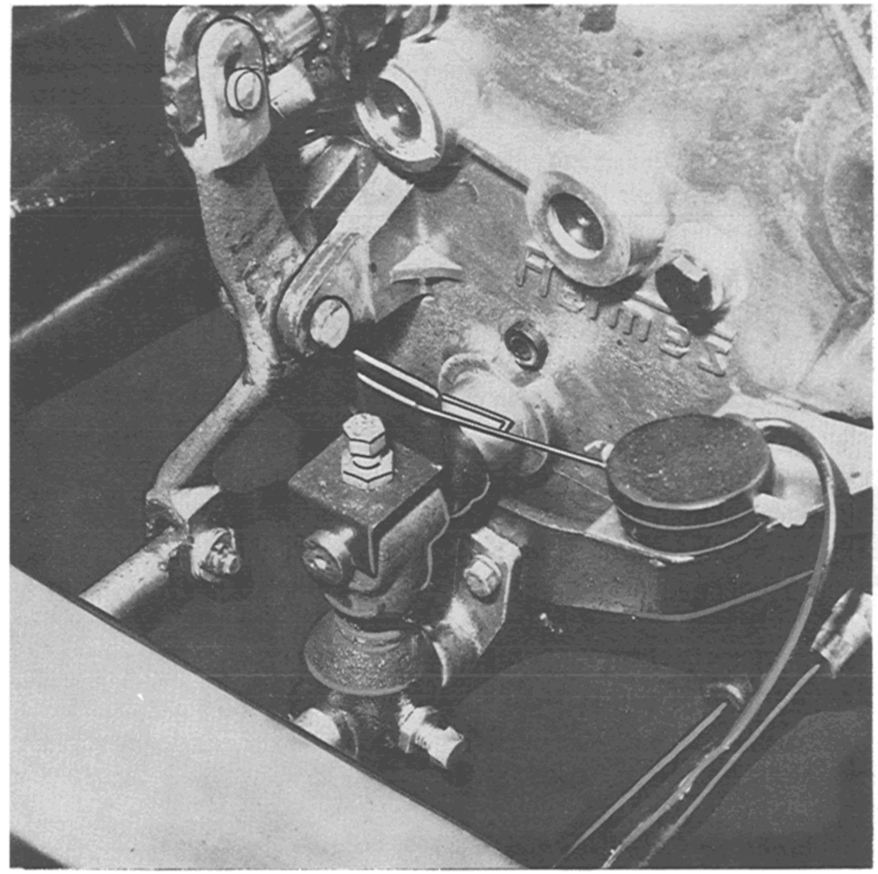

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Attention must be paid that all securing screws are fully tight, and that the gear shift mechanism is sufficiently greased.

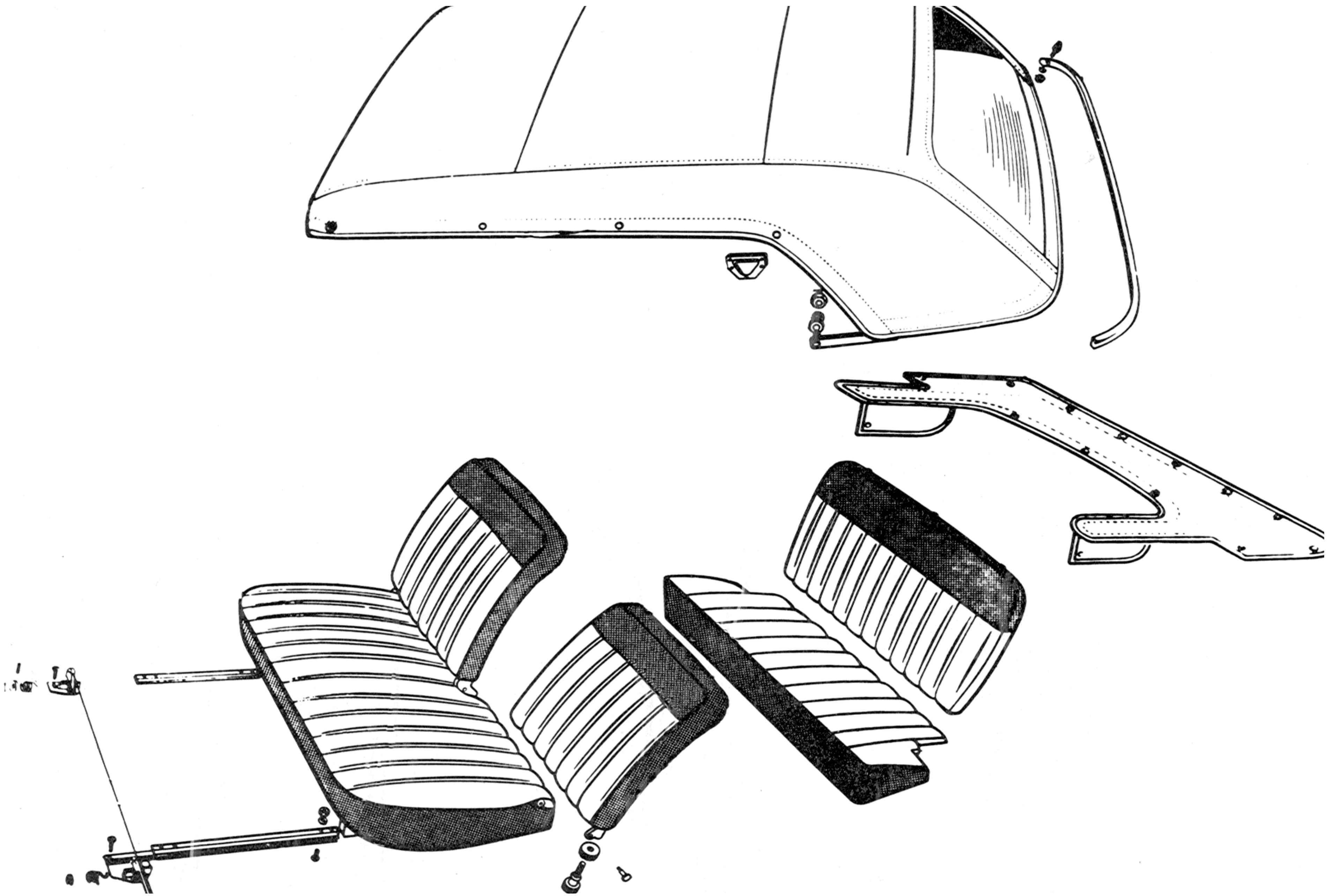
After Serial No. 103 001 the rear bearing for the operating shaft has been improved as follows: The operating shaft is lengthened, bracket mounted on transmission cover, and ball seat (female) is altered.

WATER TRANSMISSION GEAR SHIFT

The water transmission gear shift mechanism consists of the following: Gear lever, operating shaft and a connecting arm, attached to the transmission.

In case of repair to the water transmission gear shift mechanism the front and rear seats, rubber mat, floor and the rear seat base must be removed.

When reassembling, grease all joints and if necessary use distance washers on the pivot pins in order to prevent possible noises.



CONVERTIBLE TOP - MOLDINGS - GUARD STRIPS - SEATS - GLOVE COMPARTMENT INTERIOR PANELING - LIFTING JACK - TRUNK HOOD - BILGE PUMP

CONVERTIBLE TOP

A completely submersible, light all-weather hood has been provided in order to insure a smooth water trip particularly in good weather. In strong exposure to sunlight however it is possible to open (besides the four frameless, submersible side windows and vent windows) the flexible rear window by unzipping it and flapping it down. Thereby the hood acts as a sun screen under which the air may escape laterally and to the rear.

LOWERING THE CONVERTIBLE TOP

Procedure: Open snap-fasteners on the roof rims, zippers on both sides in back and at the rear window.

Open two hood snaps at the windshield frame.

Raise hood, bend, in at the hinge and let down into the hood shaft.

The hood shaft covering (enclosed in the car) is attached with the snap fasteners provided for that purpose.

CLOSING OF THE CONVERTIBLE TOP

Procedure: Unbutton covering. Pull the hood out of the shaft.

Raise until the hinges of the hood frame close.

Insert roof locating pins into the notch of the windshield frame and close top fasteners. Close zippers in the rear bilaterally as well as on the rear window.

Close snap fasteners.

NOTE: The top may be opened only in dry condition.

REMOVAL OF THE COMPLETE CONVERTIBLE TOP

Dismantling procedure:

Open zippers in the rear bilaterally and on the rear window and open snap fasteners on the roof frame.

Open top fasteners on the windshield frame.

Remove mounting screws of the rear cover strip rail and drill out rivets. Fold top back. Raise both rear quarter windows, remove rubber formed cover, and remove the three securing screws, both left and right side hinges.

Lift out the entire top.

Re-mounting is carried out in the reverse order.

NOTE THE FOLLOWING:

When remounting, the top does not require riveting in the rear underneath the cover strip. Sealing tape (Terostat tape, manufacturer Teroson Co., Heidelberg) is inserted under the hood fabric. Mount hood in rear by means of the cover strip and the mounting screws.

TOP MATERIAL REMOVAL

Open zippers laterally in rear as well as on the rear window and snap fasteners on roof frame. Open both hood fasteners.

Remove sheet-metal screws front left and right with fabric protection pieces.

Pullout rubber buffer profile in rear left and right from the frame strip.

Loosen sheet-metal screws of the frame strip and take out frame strip.

Remove bases of snap fasteners (each fastened with two sheet-metal screws).

Loosen top fabric glued to the hood frame.

Fold back top frame.

Loosen top fasteners at the cover strip. Drill out rivets.

Remove both roof locating pins.

Remove top strips from face of roof capping.

Loosen top material glued to the roof capping.

Take top fabric off.

MOUNTING OF TOP FABRIC

Measure and mark center of vehicle in rear on cover strip level.

Mark center of top fabric in rear below the rear window between both outer seams.

Also mark center of the roof capping face and on the top fabric.

Place cover loosely over the hood frame.

Insert sealing tape under the rear hood fabric fastening.

Fit hood fabric in rear (hereby observe markings).

Apply cover strip, insert center mounting screw and attach nut.

From the center attach two mounting screws each (but do not tighten firmly).

The two outer mounting screws are not to be attached as yet.

Fold back hood frame (the hood fabric is folded down backwards). Front of roof capping is attached with glue.

Observe center markings and insert the cap of the top fabric at the roof capping.

The front rim must precisely coincide with the border in front, so that good fitting is assured at the windshield frame.

Fasten hood strips below capping (center first).

Attach both roof locating pins.

Firmly tighten mounting screws of the rear cover strip.

Flap hood forward and close top fasteners on windshield frame.

Sheet-metal screws must be mounted with fabric protection pieces at the hood frame in front left and right.

Mount cover strip with hood fabric in rear bilaterally by means of the two outer mounting screws, while hood is stretched below towards front in the process.

Close zippers.

Glue hood fabric in rear left and right to the hood frame and attach mounting strip.

Insert rubber profile moulding.

Attach bases of hood snap-fasteners right and left to the hood frame.

Align snap-fastener parts in the hood material with the base parts.

Close snap-fasteners.

Slight tension (possible creases) is removed by application of a moist cloth on the closed hood.

MOLDINGS

The headlight moulding surrounds, rear lamp surrounds rear fenders and trunk cover moulding strips cover the body edges.

MOUNTING OF THE MOULDING STRIPS

Clean area on body and remove any old cement or rust.

Fit moulding: thereby pay attention that the moulding strip fits correctly over the body edges.

Avoid extreme bending, for this would result in ripping of the Eloxal film.

The rear fender moulding strip must be cut to its correct length individually.

After the moulding strip has been fitted freely and checked again for correct length, remove and insert cement compound into the groove.

NOTE: The cement compound is mixed with a hardener liquid.

Supplier: Cement compound Dr. Herbert & Co; Art — Kahapon R 2709/99503.
Hardener — Herbert R 2709/98301.

The moulding strip is applied together with a felt clad wooden strip with light alternate hammer blows, evenly. With glued-on Tesa-crepe tape the moulding strip is held at several points to the body until the cement has hardened (approximately 4 hours).

SIDE WALL MOULDING

The lateral guard strips with inserted rubber profiles offer a certain protection to the side wall of the body during docking maneuvers in the water.

These are guard strips with a buffer profile on the front and rear fenders, the doors, and at the stern.

The screwed-in end pieces boarder the buffer profiles in the guard strips.

For removal of the guard strip the buffer profile at the end pieces is pushed back to the point where the mounting screw becomes visible.

Remove and piece after unscrewing the oval-head countersunk sheet metal screw and pull the buffer profile out of the guard strip.

Remaining oval-head countersunk sheet-metal screws are to be loosened and the guard strip with support profile can be removed.

During mounting it is important to assure perfect position of the support profile. Protruding ends are to be conformed to the outline of the strip. After insertion of the guard strip buffer profile the profile is adapted (without stretching) and cut to proper length.

Press buffer profile over the screw hole of the end piece-mounting and mould end piece.

Release buffer profile from the center towards the ends.

After serial No. 103 001, the guard strips, in lieu of oval-head countersunk sheet-metal screws, are attached with Imex-metal sheet dummy rivets.

These metal sheet dummy rivets are applied by means of manual riveting tongs (supplier: Titgemeier Co., Osnabrueck).

Decorations and lettering are mounted with rubber washers and spring clips. For mounting new rubber washers and spring clips are to be used exclusively.

SEATS

The upholstered seats have nosag-springs and are filled with rubber hair-type particles, and the side panel trims are covered with imitation leather. Ball grooved rails assure easy adjustment of the front seat bench. Adjustment of the separated back rests are regulated by knurled head screws.

Seat adjustments are made by employment of the lock pawl on the left. When the lever is pressed down the seat is convertible. Upon release of the lever, the seat adjustment is automatically established.

REMOVAL OF THE FRONT SEAT BENCH

Press down lock pawl and push seat back to its end stop.

Oval-head countersunk screws are removed from the seat rail, and lock pawl with wire.

Push seat forward and loosen rear mounting screws of the seat rail.

Lift out seat.

Installation: proceed in reverse order.

GLOVE COMPARTMENT

The glove compartment is attached to the instrument panel by sheet metal screws and provided with a locking lid.

Prior to removing the glove compartment it is necessary that the defroster vent is removed from the heater.

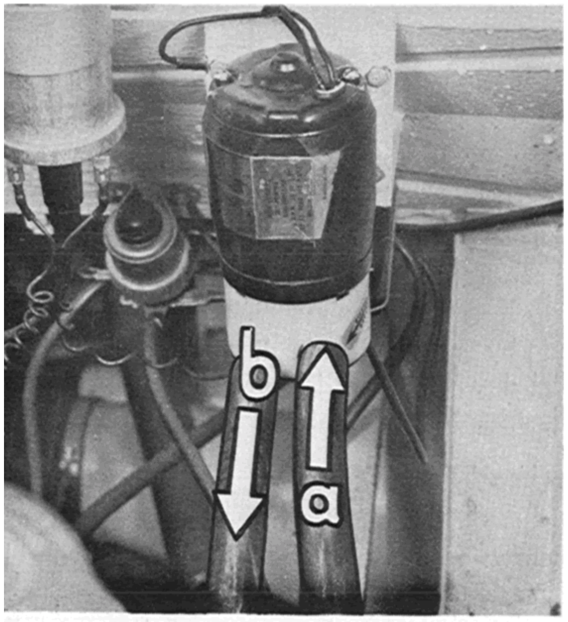
INTERIOR MATTING

Carpets for fender well, gusset plate and web plate paneling are mounted with Tivogum 7267 (Manufacturer: Tivoli Works, Hamburg).

For convertible to shaft trim Teroson 2183 cement (Manufacturer: T eroson Co., Heidelberg) is used.

LIFTING JACK

The lifting jack included in the car is fastened behind the spare wheel in the trunk.



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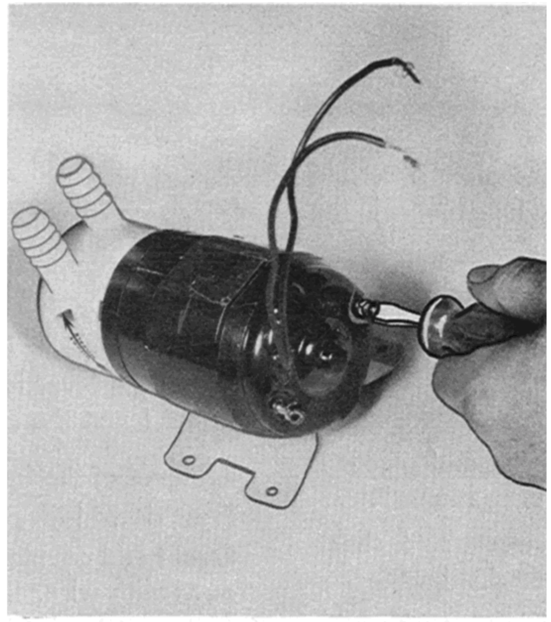

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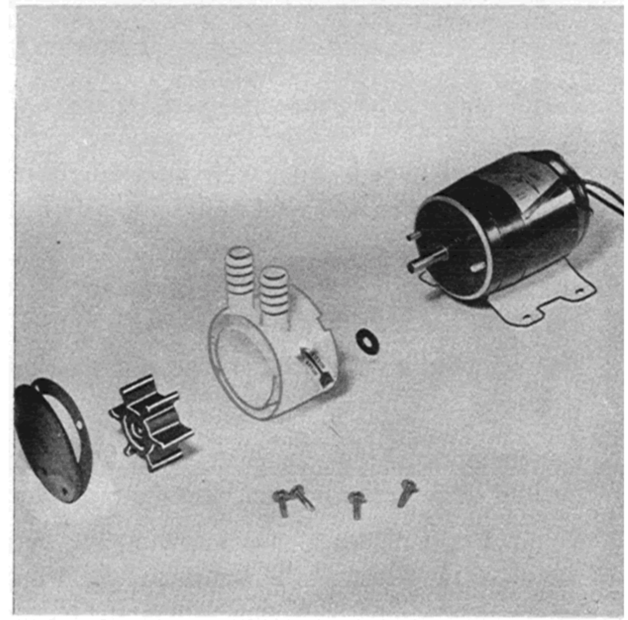

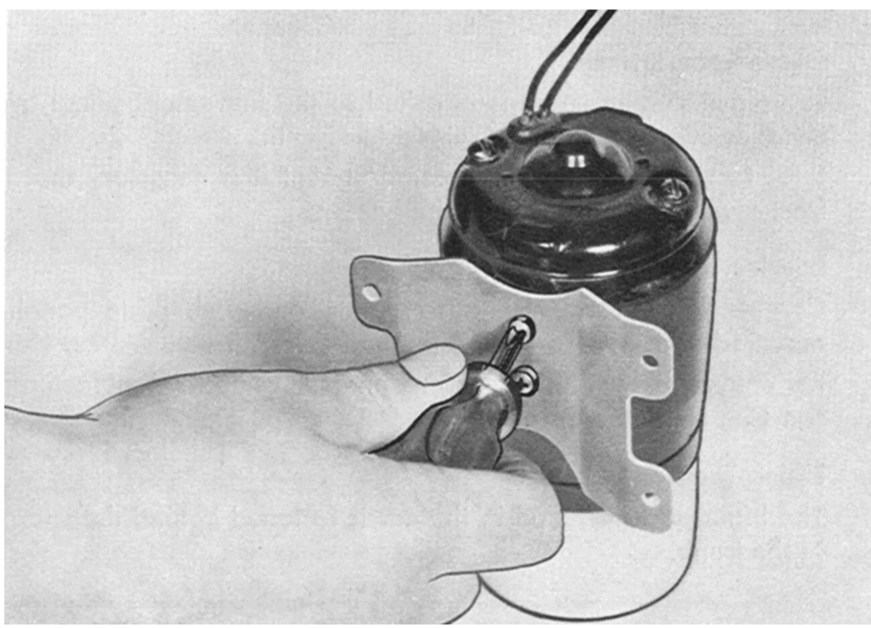

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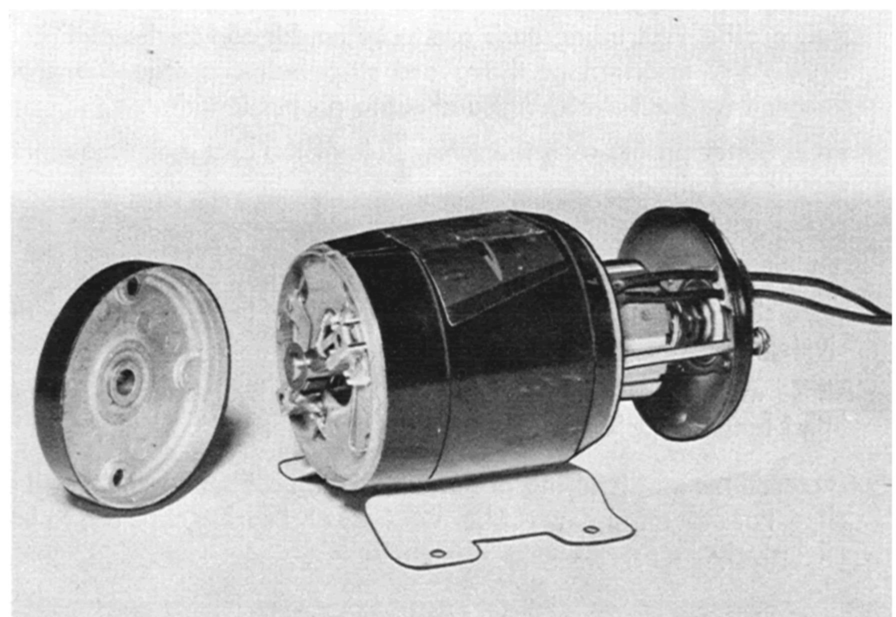


When lifting the car it is important that the car is placed on an even surface and the handbrake is locked in order to prevent rolling. Similarly the operating rod of the lifting jack is to be inserted in the truss to the stop point.

TRUNK FLOORING

The spare wheel is covered by the center part of the trunk floor consisting of three parts. To remove loosen the mounting nut of the center section. Slightly raise the center section in front, push back and lift out. Both side sections are mounted with one sheet-metal screw each. A nut under the center section mounts the spare wheel.

BILGE PUMP

The bilge pump consists of an electric motor with an input of ca. l0 watt.

Performance is 6 gallons per minute.

The bilge pump is mounted on the engine compartment firewall. Both hoses connected point towards the rear (Fig. 1).

The special rubber hose (inside diameter 5/8") laid in the bilge and connected to the intake filter, is mounted on the nozzle of the bilge pump (Fig. 1a).

The pressure hose connects the bilge pump with the outlet in the rear wall of the engine compartment (Fig. 1b).

After replacement of defective rubber hoses, the function of the mechanism should in each case be re-examined.

Please note: In case of incorrect coupling of the outlet hose the water instead of being expelled from the bilge, would be pumped in.

The bilge pump should not be operated in an unloaded condition. Dry operation results in excessive wear of the pump parts.

Apart from electric motor brushes and springs no other electrical parts of the pump can be supplied.

In the event of defect, the bilge pump must be replaced.

Control and electrical connections are shown in the wiring diagram.

REMOVING THE BILGE PUMP

1. Remove the two rubber hoses.
2. Loosen the live cable at the cable connector rail.
3. Remove the four securing screws.

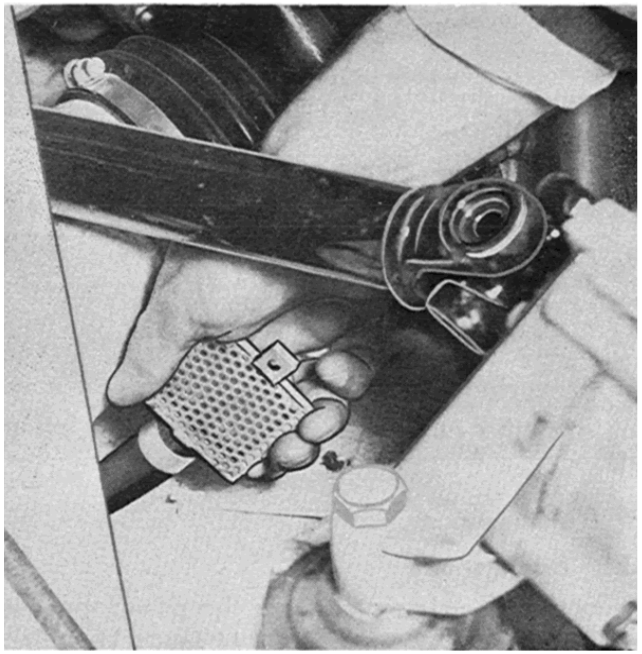
   (The earth cable of the pump is located under the left upper securing screw.)
4. Remove bilge pump.

DISMANTLING THE BILGE PUMP

In order to separate the electric motor from the pump, the two screws from the upper part of the pump are loosened (Fig. 2). The plastic casing of the pump is sealed on the flange side by a seal ring. In order to reach the impeller, the cover (four mounting screws) is removed. Fig. 3 shows the pump disassembled. For the control of the brushes and motor armature, the electric motor, as shown in Fig. 4, is disassembled.

During mounting it is important to see that the seal of the cover is properly fitted. On its bottom side the cover is marked with two arrows which indicate the flow direction of the water by the pump.

NOTE: Prior to the installation of the bilge pump in the car it is very important to assure that the mounting screws of the support bracket are firmly tightened. Between the support and the bilge pump as well as under the securing screws toothed washers are provided. These should not be lost during installation, otherwise the pump will loosen from the support (Fig. 5).



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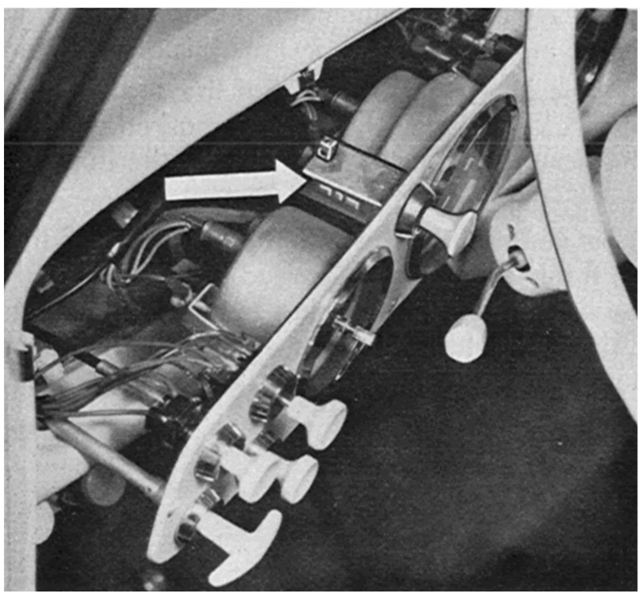

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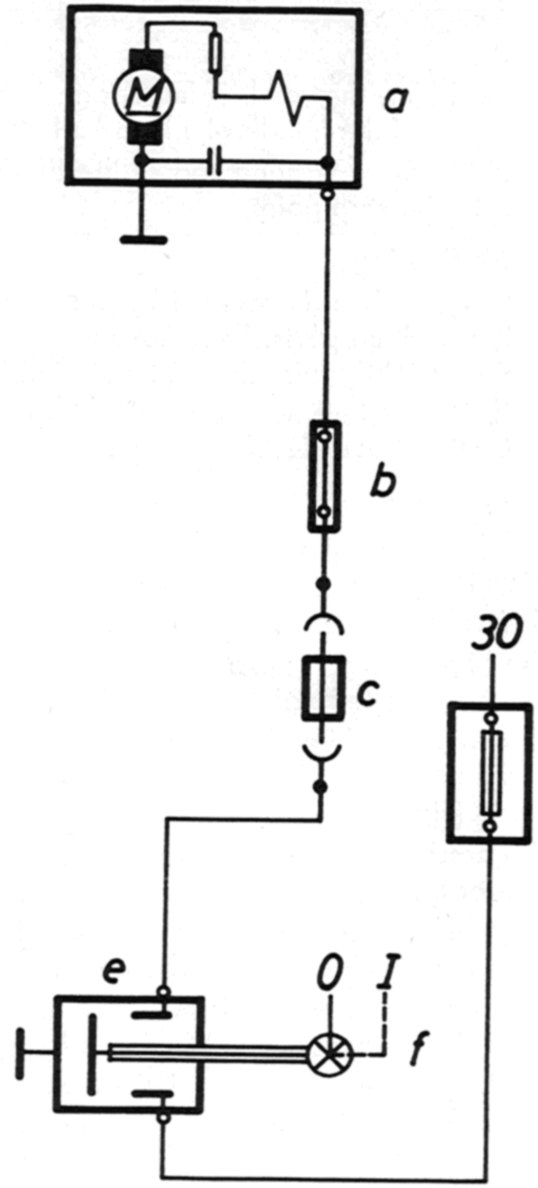

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For replacement of the mounting screws, hexagon head steel screws of equal dimensions should be used. The bilge pump does not require maintenance. Operation should be examined at every maintenance service. If necessary, the suction filter (Fig. 1) should be cleaned, or brushes and springs replaced.

BILGE PUMP SWITCH

The bilge pump switch with the blue control light is mounted on the instrument panel assembly between speedometer and electric clock. It is a push and pull switch with two positions (on and off).

Upon pulling of the switch the circuit of the bilge pump and the blue control light (in the switch button) is closed.

NOTE: The control light is not included in the bilge pump circuit. The burning of the control light does therefore not guarantee that the pump operates, but merely that the power supply to the pump is established (Fig. 3).

Explanation to Fig. 3.

a = bilge pump

b = cable connector

c = plug contact

d = fuse

e = bilge pump switch

f = control light in the switch

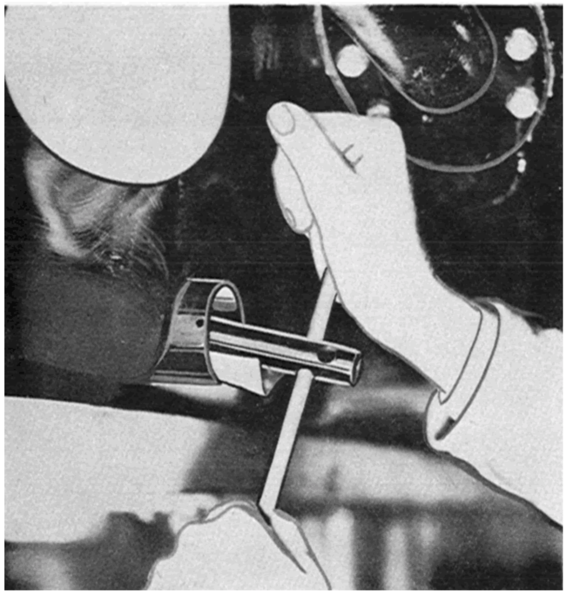
In the older model the circuit is protected against overcharge directly at the bilge pump switch by an 8 amp. glass-tube fuse. The fuse is accessible from the trunk compartment.

In the new model the fuse 8 A is positioned in the fuse box.

The removal of the switch is possible after removal of the button and after loosening of the ring nut.

It is important during the installation that the connecting plate of the switch is placed in such a manner that short-circuit even during removal of the instrument assembly is impossible (Fig. 2).

A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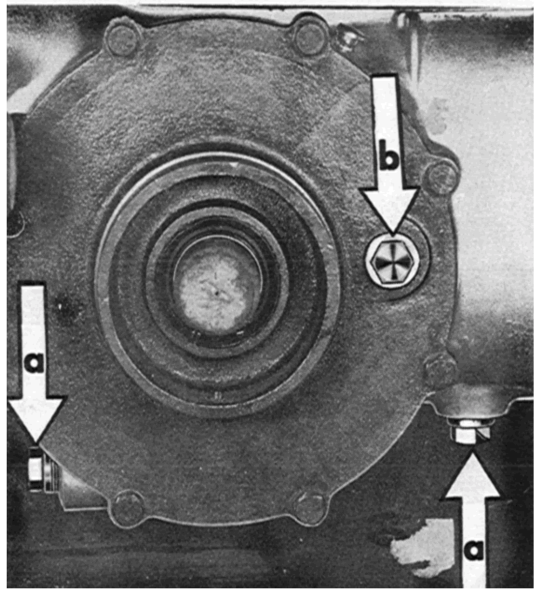

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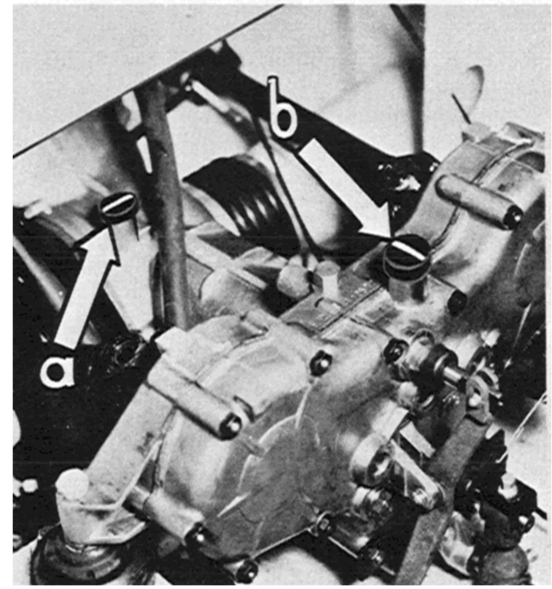

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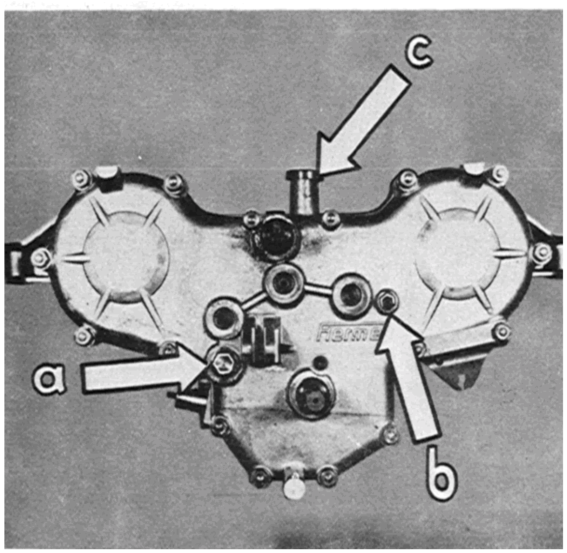

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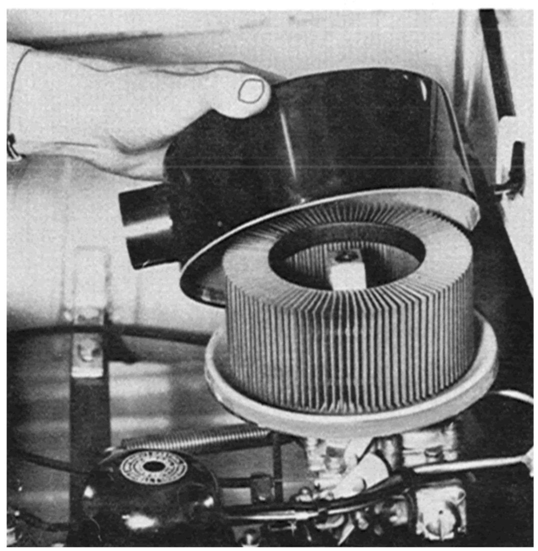
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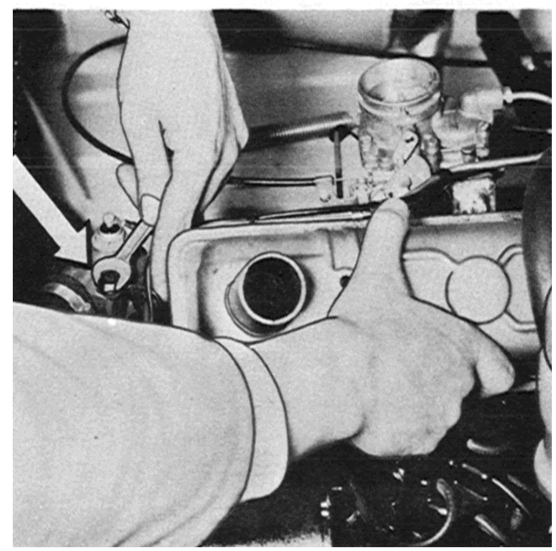
6

1. CONDITION ROAD TEST OF VEHICLE (1)

Before commencing a maintenance service, attention must be given while road testing, to find out which defects the vehicle has, great attention should be paid to the straight-ahead pulling of the vehicle.

Also check the performance of the engine, body noises, steering, straight ahead steering of vehicle, gear shift, the warning lights for oil pressure, ignition, and water temperature, most important is checking the water tightness of vehicle.

Should any defects be found on the vehicle which may not be included in the maintenance chart, then the customer should be informed from the art of repair which is necessary, and needed time for repair.

A regular, planned mileage maintenance program will assure many miles of driving pleasure. Better car performance for a longer time, lower operating costs, and greater driving enjoyment are only some of the advantages, to be realized by following the prescribed recommendations.

The car owner is responsible for seeing that his car is lubricated at the recommended mileage and also for the specified selection of materials used.

ENGINE OIL CHANGES (2)

The frequency of engine oil changes should be related to the conditions of use to which the vehicle is subjected. A period of 1600 miles is recommended for average conditions equivalent to approximately 25 hours water driving. This period should be reduced for the following unfavorable conditions.

A) Habitual stop-start-driving

B) Operations during cold weather, especially with (a) or when appreciable engine idling is involved.

C) When much driving is done under dusty conditions.

If the vehicle is only driven in water, then approximately after 25 hours of running, the engine oil should be changed.

To drain the engine, remove the drain plug situated in the Bilge, at the rear R/H side, Figure 1 through this plug hole slacken the engine sump drain plug, and insert a conduit pipe into the hole before finally removing the sump drain plug.

Should while carrying out this operation oil entry the Bilge, no damage can occur, for all rubber grommets, hoses and rubber jacket are oil resistant.

By raising the vehicle at the front all liquid can be drained off through the Bilge drain plug hole. It is not recommended to use the Bilge pump for this purpose, for at the hose outlet nozzle an oil stain would appear on the paint finish.

Re-fit both drain plugs, and re-fill engine with 7 pints of engine oil as recommended, in the following chart, accordingly to weather temperatures.

Lift off the cap situated on the rocker cover to replenish the oil. It is easier and cleaner to change the oil with an automatic oil suction machine, the nozzle of this machine must be inserted into the dipstick hole to suck the old oil out, it is therefore not necessary, to remove the drain plugs.

RECOMMENDED OILS

TEMPERATURE

Above	70º F	SAE 30 10w/30 or 20w/40
from 70 to	+35º F	SAE 20 10w/30
Below	30º F use brands	SAE 10 10w/30
Below	10º F HD-Oils only	5w /20+

+ Use under extreme colder conditions.

MATERIALS ADDED TO ENGINE OILS

We do not advocate the use of any materials that are to be added to engine oils.

Lubricant refiners develop their products to satisfy engine lubrication requirements, and other materials added generally do not improve the efficiency of the product.

ENGINE OIL LEVEL (3)

Every 250 miles or weekly, whichever occurs first, withdraw the dipstick, wipe clean, insert and push fully home before withdrawing it for reading. Should the level be at the lower mark on the dipstick, 2 pints of oil will be required for topping up we recommend always to use the same type of oil for topping up.

TRANSMISSION OIL CHANGE

To obtain entry to the control and drain plug of the transmission, it is necessary to remove the rear seat and back rest, and unscrew the seat base fastening screws which are situated and covered with a rubber strip on the front edge of the seat base. The seat base must be raised at the front edge and withdrawn.

The four speed transmission and water transmission box form a complete unit, but are divided with a radial oil seal, that means both for speed and water transmission must receive attention separately.

FOUR SPEED TRANSMISSION OIL CHANGE (4)

Change oil after the first 350 miles and then every 12000 miles. It is recommended to remove the transmission oil when warm by using an automatic oil suction machine with the tube end inserted into the vent hole.

Re-fill with 4.4. pints of oil SAE 90.

ALTERNATIVE WAY TO CHANGE THE TRANSMISSION OIL

Remove both drain plugs as shown in figure a. This operation is rather difficult, and the drained off oil will run into the floating body, which then has to be drained off through the bilge drain plug hole, as described on page A/3 engine oil change.

TRANSMISSION OIL LEVEL

Remove the control plug screw fig. 2 b in the differential cover and check the oil level every 3000 miles.

After refitting the control-plug screw, the vent plug must be fitted as shown in figure 1a with the red paint mark parallel to the rear axles, if fitted incorrectly the oil will be forced out.

WATER TRANSMISSION BOX OIL CHANGE (6)

To obtain entry to the water transmission box, pay attention to gearbox oil change described on page A/4.

Change oil after the first 350 miles and then every 12000 miles, with each maintenance. Use gearbox oil SAE 90.

Remove vent plug, and insert the automatic machine suction tube. Remove the control plug screw of figure 2 b, page A/2, and re-fill 1,760 imp pints of oil into the vent plug hole, until the oils starts to run out of the control plug hole.

Refit the control plug and the vent plug so that the red paint mark is positioned in driving direction.

Should no automatic suction machine be available, then remove the drain plug fig. 2a, page A/2.

The oil will run into the floating body which then has to be removed by raising the vehicle at the front and draining the oil out of the Bilge drain plug hole.

No damage can occur to the rubber hoses and rubber parts, for these are oil resistant.

RENEWING THE OIL FILTER (8)

1. Every 6000 miles renew the oil filter.
2. After removing the old filter, clean all traces of adhesive from the adaptor surface.
3. Smear sufficient grease in groove of filter and always fit a new sealing ring and smear with grease.
4. Screw in filter as tight as possible using both hand, filter body and hands to be dry and clean to achieve max. Tightening torque (this should be equivalent to 15.18 lbs. ft. torque).
5. Check that there is metal to metal contact between ridge on filter body and adaptor face all round. It is essential that this condition is achieved, if there are any gaps reject filter and fit ,another.
6. Run engine at varying speeds for five minutes to ensure repeated operation of pump relief valve to fully pressurize filter.
7. Retighten filter to 15.18 lbs. ft. torque or equivalent by hand.
8. Check for oil leaks.
9. Finally, check oil level in sump and top up if necessary.

AIR CLEANER (9)

Every 6000 miles renew the paper element, under dusty conditions clean the element more frequently.

CLEANING THE PAPER ELEMENT (10)

Every 3000 miles unscrew the retaining screw and detach the cover from the air cleaner. Remove the paper element from casing and, with a low pressure, compressed air line or a soft brush, clean between the folds of the paper. Clean the interior of the casing and re-fit the element and cover, securing this by tightening the screw. (Page A/2, Fig. 5)

CHECK AND TIGHTENING CYLINDER HEAD NUTS (11)

The checking and tightening of the cylinder head nuts, if necessary after the first 350 miles, carry out as follows:

1. Remove the oil filler cap, and air cleaner loosen both securing nuts with washers from the rocker cover.
2. Loosen the thermostat bolt holding the fuel pipe bracket. Turn the bracket enough to enable the removal of the rocker cover. (Page A/2, Fig. 6)
3. After the rocker cover removal, retighten the thermostat securing bolt.
4. Remove the small cover from engine partition. Unscrew the rocker shaft pedestal four securing nuts with plain washers, and remove the rocker shaft.
5. Unscrew the exhaust front and rear mounting brackets from the cylinder head.
6. Using a torque wrench check and tighten the cylinder heat nuts to 42 - 46 ft. lb. torque in the same sequence as shown in figure 3, page 1/14.

Refitting in the reverse order, but after fitting, the rocker shaft, the rocker clearance must be reset as described under valve clearance adjusting. Position 12, page A/6.

NOTE: Before refitting the rocker cover check that the gasket is in good condition, if necessary replace. Tighten the rocker cover nuts only sufficient to ensure on oil-tight joint. Position the fuel pipe bracket on the thermostat correctly.

ADJUSTING THE VALVE ROCKER CLEARANCE (12) EVERY 3000 MILES.

1. Remove the air cleaner and the oil filter cap.
2. Unscrew the rocker cover, securing nuts and loosen the one thermostat securing bolt of the fuel pipe bracket, and turn the bracket a little to one side. Remove rocker cover.

NOTE: The engine must be cold before setting the valve rocker clearances.

Firing order is 1-3-4-2.

Clearances Are Inlet and Exhaust 0.010"

3. It is most important when setting rocker clearances that the tappet is seating on the back or round portion of the cam contour. This position is obtained by first turning the crankshaft until No. 1 push rod has reached its highest point, then rotating a further full revolution.
4. To adjust No. 1 rocker, slacken the locknut, and insert an accurate feeler gauge of 0.01011 thickness between the rocker and valve stem as shown in figure 1, page 1/25.

Turn the adjuster with a screwdriver until very slight resistance is felt as the gauge is moved across the valve stem, then retighten the locknut.

It is advisable to re-check the clearance after tightening the locknut and to readjust as necessary.

Deal with the remaining rockers in a similar manner, ensuring that each rocker is correctly positioned before attempting to adjust it.

Examine the rocker cover gasket and if its surface is chipped or suspect in any way, replace the gasket.

Locate the cover on the cylinder head and secure it by refitting a fibre washer, plain steel washer and self-locking nut to each rocker cover studs. Tighten the nuts only sufficiently to ensure an oil-tight joint. Position the thermostat bracket correctly and refit air cleaner and oil filler cap.

RENEW THE SPARKING PLUG EVERY 12 000 MILES (13)

CHECKING SPARKING PLUGS, CLEANING AND GAP SETTING (14)

Every 3000 miles the sparking plugs must be removed, checked and cleaned.

1. Remove the sparking plugs and check the plug face condition, for the plug face and insulator can show the condition of the engine tune and condition.

For example:

Color	Middle gray:	Rich mixture and normal condition.
	Light gray:	Weak mixture.
	Black:	Mixture too rich.
	Oily:	Worn out plug, broken piston ring.

2. Clean the plug with a brush or in a plug cleaner machine. The insulator on the outside must be clean and dry.
3. Check the electrode cap and adjust 0.025" plug type: Lodge C NY 1/2" reach.
4. Smear the threads of the plug with graphite grease before refitting to prevent the possibility of seizure.

RESETTING THE DISTRIBUTOR CONTACT BREAKER POINTS EVERY 3000 MILES (15)

1. Take off the distributor cap and remove the rotor arm. Turn the engine clockwise until the contact breaker opens to its widest position.
2. Examine the contacting surfaces of both contacts for traces of burning and "pitting and pilling".
3. Clean the contacts with a small carborundum stone, but care must be given to keep the surfaces flat with each other to maintain maximum contact area.
4. With the contacts points still fully open check the gap and reset to 0.015" by slackening the screw and making the necessary adjustment and re-tightening.

DISTRIBUTOR CAM

A) Every 6000 miles detach the distributor cap and withdraw the rotor arm. Smear the cam lightly with oil and apply a few drops of thin machine oil around the edge of the screw. Place a single drop of oil on pivot.

B) Clean the distributor cover, inside and out, with a soft dry cloth paying attention to the spaces between the metal electrodes. Ensure that the carbon brush moves freely in its holder.

C) Refit the rotor arm, carefully, locating its moulded projection in the keyway in the spindle and pushing on as far as it will go. Refit distributor cap.

IGNITION TIMING AND TUNING EVERY 3000 MILES

The initial timing may be obtained as follows:

1. Rotate the crankshaft until the inlet valve of No. 1 cylinder is open, this may be observed after removal of the oil filler cap, from the rocker cover.
2. The timing is 150 B.T.D.C. measured on the crankshaft pulley 9/16" before the mark on the timing chain.
3. Connect a test lamp to connection 1 on the coil and the second to earth, the fine adjustment on the distributor knurled thumb screw should be showing 21/2 on the scale.
4. Turn crankshaft in running direction until the test lamp lights at the correct advance ignition, if the light should not light up, slacken the distributor clamping bolt and turn until the test lamp lights up.
5. Of course before correcting the ignition timing, the distributor contact points should be correctly set see distributor contact breaker (position 15).
6. Retighten the distributor clamping bolt.
7. Recheck the ignition setting by again turning the crankshaft slowly and checking that the test lamp lights up at the correct setting of 9/16" B.T.D.C. on the crankshaft pulley with the marking on the timing chain cover.

CLEANING THE OIL FILLER BREATHER CAP (18)

Every 6000 miles lift off the oil filler cap, swill in fuel, and dry off with a clean cloth or low pressure air line. Refit the oil filler cap.

CLEANING THE FUEL PUMP (19)

1. Every 6000 miles close the fuel cock. Remove the pump dome cover, detach and clean the filter gauge.
2. Remove any sediment from the filter chamber then refit the gauge and dome cover, but take great care not to cover-tighten the dome cover retaining screw.

CLEANING THE FUEL COCK BASKET STRAINER (20) EVERY 12000 MILES.

1. Close the fuel cock, and unscrew the filter cup, using a 17 mm open wrench.
2. Unscrew the basket strainer, and together with the filter cup, wash in clean gasoline, finally drying with compressed air.
3. Before refitting, check that the outlet hole is free.
4. Take care not to damage the basket strainer by over tightening. It is advisable to smear the thread of the filter cup with graphited oil, this will prevent seizing of the threading.
5. After assembling, check the tightness of the fuel cock, and that there are no leaks.

   ATTENTION

   Always Replace the Filter Cup Seating Ring.

CLEANING THE CARBURETTOR EVERY 6000 MILES (WITH CARBURETTOR FITTED) (21)

1. Detach the air cleaner and disconnect the fuel pipe.
2. Remove the retaining screws, spring washers, and detach the top cover and gasket. Lift out the spindle, float lever and float.
3. Remove the plug with aluminum washer from the float chamber using screwdriver, remove the main jet.
4. Unscrew the pilot jet and the air correction jet from the carburettor body. Remove the valve plunger then detach the accelerator pump nozzle.
5. Detach the retaining screws from the accelerator pump body, remove the body and swing it to one side on the pump lever.
6. Remove the diaphragm and spring. Take care not to lose the ball valve from its seating within the accelerator pump chamber.
7. Using clean fuel and a compressed air line, clean out the float chamber, and passages within the carburettor body and various jets. Reassembling is in the reverse order but if necessary replace the top cover gasket.

CHECKING FAN BELT TENSION AND DYNAMO MOUNTING BOLTS EVERY 3000 MILES (22)

The belt is correctly tensioned when on the longest length a 1/2" slack is obtained. By too slack tension the belt can slip and thus cause a bad performance of the dynamo and cooling system and also cause extreme wear to the belt. Over tensioning can cause wear and damage, to adjust slacken the dynamo mounting bolts and move the dynamo until the correct belt tension is obtained. Retighten bolts to the correct torque as described on page 1/11.

CHECK FAN BELT TENSION AND DYNAMO MOUNTING BOLTS EVERY 3000 MILES (22)

The belt is correctly tensioned when a deflection of 1,5 cm is obtained. By too slack tension the belt can slip and thus cause a bad performance of the dynamo and cooling system and also cause extreme wear of the belt. Over tensioning can cause damage to the dynamo bearings.

To adjust the belt loose the dynamo mounting bolts and move the dynamo until the correct belt tension is obtained.

Re-tighten bolts.

CHECK COOLING AND HEATING SYSTEM FOR FUNCTION AND FOR LEAKS EVERY 5000 MILES

Check condition of hose clip. Porous and damaged water hoses have to be renewed.

Should any defects be found in the heater caused by air bubbles in the heating system ventilate the unit at the heater and at the heater hose on the cylinder head.

VENTILATION OPERATION

Check water in the radiator, top up if necessary. Loose air vent screw at the heater.

Should water drain without air bubble, re-tighten air vent screw. The second ventilation system is situated in the engine compartment above of the rear valve cap mounting screw on the highest place of the water hose.

Loosen the plug too so that the air pad can escape.

CHECK RADIATOR WATER LEVEL (24)

If the engine is hot exercise extreme care when opening the filler cap as it may occur an over-pressure in the radiator according to the heated water.

GREASE WATER PUMP (25)

Remove water pump plug and insert lubrication nipple every 12000 miles.

Fill in only five bumps by using the hand grease gun packed with water pump grease.

Remove lubrication nipple and screw in plug.

ADJUST BOLTS OF ENGINE, GEARBOX, RADIATOR AND EXHAUST; CHECK MOUNTINGS (26)

Check condition of unit bolts every 9000 miles (see table 1/11, torques). Check mountings of engine and gearbox. Renew broken and torn rubber parts.

CHECK CLUTCH PEDAL TRAVEL EVERY 3000 MILES, ADJUST IF NECESSARY (27)

It is essential that a dead travel of at last 20 mm be available at the clutch pedal. Should there be no travel the clutch will become useless and the graphite ring is wearing.

The adjustment of the clutch pedal travel has to be made at the clutch release fork (see page 1/128, fig. 2).

To reach the nuts it is necessary to remove the rear seat, the back rest and the seat base as described on page 1/11, fig. 1 and 2.

CHECK PLAY OF STEERING, ADJUST IF NECESSARY (28)

Should a play of steering be found to the straight-ahead pulling then it has to be checked the position of the play by moving the dead travel. If this should not be caused by the steering arm the steering has to be adjusted. The extreme play of the steering arm should not be higher than 30°.

Carry out as follows:

Put the car on blocks;

Turn the steering straight-ahead;

Loosen counter nut and adjusting screw in the steering gear; Adjust play.

The steering never cause the shimmy of front wheels. Avoid by short adjusting the steering. But this has only a short success and damage the steering gear. The great play of the ball-and-socket' joint, the stub axle bearings as well as the unbalanced tyres often cause the shimmy. Make sure that the tyres are always balanced.

CHECK STEERING BOX OIL LEVEL EVERY 6000 MILES (29)

Checking has to be made at the box cover plug, i.e. the oil must be re-filled up to the lower edge of the filler hole. Use only gear oil SAE 90.

CHECK THE GEAR SHIFT MECHANISM (30)

After removal of bowden plate check the gear changing every 3000 miles. Should any defects be found, such as labouring of the linkage, then the defect must be repaired.

CHECK STEERING MOUNTING BOLTS (31)

Special care is required when checking the condition of both the steering arm and the caster rod. This work has to be done every 3000 miles as it is of great importance to the road safety. Note the torques as shown on page 1/11.

CHECK TOE-IN EVERY 6000 MILES (32)

It is very important to have correctly adjusted the front wheels as the extreme wear of wheels will negatively influence the steering function.

The amphicar, Model 770, is adjusted as follows:

Toe-in:	Plus 1 - 3 mm (= 10' - 30')
Camber:	Plus 1° - 45'
Inclination:	4°
Caster:	6° - 30°

WHEEL CHANGING (33)

It is recommended to change the wheels every 6000 miles. The best method is described on page 7/16, fig. 2 showing the changing of the wheels turning direction.

CHECK RUBBER SEALERS ON GEARBOX, HANDBRAKE CABLES AND STEERING BOX FOR POROUS AND TIGHTNESS OF CLIPS EVERY 3000 MILES (34)

To avoid penetration of water during water drive special care is required when checking the rubber sealers. Renew porous and damaged rubber sealers.

REMOVE BRAKE DRUM, CLEAN BRAKE SYSTEM AND CHECK FUNCTION OF WHEEL CYLINDER EVERY 6000 MILES (35)

Defects and repairs are described in group 6.

CHECK FOOT AND HANDBRAKE, ADJUST IF NECESSARY EVERY 3000 MILES (36)

Adjust brakes if the reserve should be under approx. 1/3 of the total pedal course. Put the car on blocks so that each wheel can be turned. The brake shoes have to be turned against the brake drum by adjusting the eccentrics and then loosened as far as the brake drum can be turned. The front axle is equipped with Duplex brakes. Both eccentrics will be moved in the same turning direction to pull them to the left hand side and to loose to the right hand side. The wheel cylinder determines the turning direction of the rear brake adjusting screw, i.e. turn the eccentric adjusting to loose the handbrake to the wheel cylinder and pull in the opposite direction.

The adjustment of the handbrake has to be made at the handbrake cable and only after adjusting the service brake.

After adjusting no slipping of the brake drum may be occurred.

CHECK AND TOP UP THE BRAKE FLUID CONTAINER EVERY 3000 MILES (37)

Should brake fluid be drained caused by leaky line, piston cup etc. top up the fluid container to 20 mm under the rim.

CHECK CONDITION AND TIGHTNESS OF BRAKE HOSES EVERY 3000 MILES (38)

The condition of the front brake hoses is described on page 6/16, fig. 1.

Should a damage be found at a brake hose check the condition and repair the defect. It is absolutely necessary to change the damaged brake hoses.

CHECK FUNCTION OF ALL BOWDEN CABLES EVERY 6000 MILES (39)

Remove, lubricate or if necessary renew the Bowden cable to avoid laboring.

CHECK FRONT WHEEL BEARINGS PLAY, ADJUST IF NECESSARY; ALSO CHECK PLAY OF REAR WHEEL BEARINGS AND DRIVE SHAFTS EVERY 6000 MILES (40)

Remove rubber cap and split pin if play be found in the front wheel bearings. Re-tighten castellated nut to 3 mkg torque and then return to 60°. The brake drum may not be axially displaced but must be turned without play. Take great care to this adjustment. Provide castellated nut with split pins, top up the rubber cap and assemble.

The rear wheel bearings are not adjustable. Renew the wheel bearings if play be found. It is advisable to put the car on blocks (rear) and to remove the rear wheels when checking the drive shafts. Extreme wear of drive shafts in the universal joint win be found after changing a gear by turning the brake drum (loosen hand brake).

CHECK WHEEL HUB RUBBER CAPS FOR CONDITION (41)

The front hub caps will be checked and removed every 6000 miles. Renew porous and damaged ones. After repacking with grease the caps will again be assembled.

CHECK STUB AXLE BOLT AND THRUST BEARINGS EVERY 6000 MILES (42)

After putting the vehicle in front on blocks check the thrust pea rings. Take off the split pins, re-tighten and loosen 1/6 rotation. Provide the castellated nut with split pins.

CHECK STUB AXLE BOLT WITH OSCILLATING SHAFT, COMPENSATE IF NECESSARY (43)

After putting the vehicle in front on blocks the play will be checked. See under group 5, page 7, if a compensation or a repair should be necessary.

CHECK PLAY OF FRONT AND REAR AXLES (44)

Unpleasant noises will be heard if the play of the axles will be.. too great. Put the car on blocks for checking the play. The experiences on adjusting and repairing are described in group 4, page 7.

CHECK SHOCK ABSORBER MOUNTINGS EVERY 6000 MILES, RE-TIGHTEN IF NECESSARY (45)

A torque of 7,8 mkg must be obtained.

CHECK ALL BOLTS, SCREWS AND NUTS OF BODY EVERY 6000 MILES, RE-TIGHTEN IF NECESSARY (46)

Torque in the same sequence as described.

CHECK WHEEL NUTS FOR TIGHTNESS EVERY 3000 MILES (47)

Re-tighten wheel nuts with a torque of 11,2 mkg.

CHECK TIRE PRESSURES EVERY 3000 MILES (48)

Front tire pressure:	1 atu
Rear tire pressure:	2, 1 atu

CHECK OPERATION OF ALL ELECTRICAL COMPONENTS, ADJUST HEAD LAMPS IF NECESSARY (49)

Repair defects.

CHECK FUNCTION OF DYNAMO AND STARTER MOTOR EVERY 12 000 MILES (50)

CHECK DYNAMO CARBON BRUSH EVERY 24000 MILES (51).

The interchange of carbon brush is described in group 1, page 101.

OIL DYNAMO (52)

Give dynamo a few drops of oil every 12000 miles.

CHECK FUNCTION OF BILGE PUMP AND CLEAN SUCTION FILTER (53)

The bilge pump is almost free of maintenance. Check function every 6000 miles. Clean bilge if defects have been found through soilings. Therefore it will be necessary to tighten both hoses and to remove two bolts. The bilge pump may only be used for conveying water. To clean the suction filter remove the rear seat, the back rest and the seat base. The suction filter is mounted through a nut. After removal wash the suction filter (see page 12/10, fig. 1).

CHECK BATTERY ELECTROLYTE AND DISTILLED WATER LEVEL (54)

After checking battery electrolyte top distilled water up to the white marking. Use only distilled water. Should the battery be soiled and the poles oxidized, remove and clean the battery. After cleaning, grease poles and terminals. Do not use fire to check the battery, the gases caused by the battery may explode. Check the battery electrolyte between each inspection.

LUBRICATE DOORS, TRUNK LID, DUTCH LID HINGES, ADJUST IF NECESSARY EVERY 3000 MILES (55)

It is most important to use suitable adhesive when renewing porous and damaged weather strips (see group 11, page 7).

LUBRICATE THE VEHICLE (57)

Lubrication of all movable parts has to be performed with greases containing molybdic sulfate.

It would be recommended to grease only with a hand grease gun and to use only Molycote grease BR 2-S. By this a minimum wear and longer lubrication terms are obtained.

Figures of the lubrication points are shown on the main page of this group.

WIPE CLEAN DOOR HANDLES, GEAR SHIFT AND STEERING WHEEL (58)

After every inspection check that there are no soilings on the vehicle or on the padding caused by the mechanic.

The vehicle must be handed over to the customer in best condition. Door handles, gear shifts and the steering wheel must be cleaned.

REMOVE WAX CONSERVING MATERIAL FROM BODY (59)

The wax conserving material has to be removed from the body of the new cars by using the cold cleaner 769 E produced by Messrs. Henkel & Co. Approx. 1 1/4 kgs are needed.

Operation of wax removal:

Soak a sponge with cold cleaner and rub in the body (the cold cleaner may not be drained). After 8 to 10 minutes wash the body with soap solution and rinse with fresh water. After having cleaned the body with a leather polish same.

TEST RUN, ADJUST CARBURETER

The test run will be made after finishing the maintenance.

Pay attention to the defects being repaired.

After driving in water check the car for leaks and the units for tightness. If the crankcase is hot adjust the carbureter as described in group 1/81.

BATTERY

MAIN CHARACTERISTICS:

Potential: 12 V

Capacity: 32 Ah (should uncharging period be 20 h)

Length: 238 mm

Width: 139 mm

Height: 225 mm

Weight: with acid approx. 15,5 kgs

The battery is situated on the right hand side of the engine compartment. Use only special pole cleaner and a wire brush for cleaning the battery terminals. In order to avoid corrosion lubricate the parts with battery terminal grease (acid less petrolatum). The acid level indicated through a white marking must be 5 mm over the rim of the partition plates. Use only distilled water to obtain the correct level or to thin the acid. To obtain longevity of the battery regularly check and maintain same. Check acid level between each inspection.

CHECK CHARGING CAPACITY:

Pay attention to the following values which are considered for different charging capacities and a temperature of +20° C to check the charge density by using a hydrometer:

Density:

1.26 +/- 0.05 Be

1.23

1.21

1.19

CHARGING CAPACITY OF BATTERY:

100%	(tropics 1,23 +/- 0,05) Be
75%	(tropics 1,20)
50%	(tropics 1,16)
25%	uncharged (tropics 1,09)

Take care that the charge density of a charged battery will be 1,26 and not as usual 1,28. Check these values by completely charging the battery and having a temperature of 200 C. Should an acid of 1,28 be used, carry out as follows to obtain 1,26:

Take off 35 ccm (1,28) acid

Top up with 35 ccm distilled water

Mix thoroughly

Charge each hours

Pay attention to the start ability and capacity for checking function. Should the maximum ampere be 3,2 A* charge the battery until a lively boiling is obtained in all batteries. * (= 1/10 of the capacity)

NOTE: The positive terminal is situated on the chassis as mass.

CARE AND MAINTENANCE OF THE PAINTWORK

Care of the body paintwork is restricted to regular cleaning and polishing.

Unless care is taken during the cleaning and polishing operation; fine scratches will. occur on the surface of the paint. These scratches can often be traced to fine particles of dust on the surface of the paintwork, sponges, chamois leather, and polishing duster. Always use a good polish and never apply the polish to a dirty surface.

When washing down, preferably with running water from a medium pressure hose, ensure that all surface grit is removed.

All foreign matter which could stain the finish, such as gasoline, tree sap, road tar, excretion from insects and smoke from factory chimneys, contain harmful chemicals and other foreign matter that may permanently damage the finish of your car if not washed off promptly. Tar stains may be re-moved with petrol, white spirit, or, in obstinate cases, eucalyptus oil.

The need for cleanliness, at all times, cannot be too highly stressed.

Special care, however is required when carrying out maintenance work and during the handling of cars, finished in light colors. Fitters with dirty overalls should not lean against the car or touch the paintwork with greasy hands as paint staining can result from the briefest of contact. The staining may not become evident immediately, but after a short time in the sunlight some discoloration may become apparent.

The areas affected by this form of staining cannot De treated successfully and any relief obtained from the use of abrasive polishes will only be a temporary character.

The continued use of burnishing pastes will cause excessive wear of the finished surface, and this should be avoided.

Deep scratches ,and other paint damage should be re-paired without delay, or "rust-creep" will extend the area of damage.

CHROMIUM AND BRIGHT PARTS

These require cleaning to preserve their bright tones and to avoid corrosion. Any chrome cleaner and polish may be used for this purpose.

BEAUTY CARE INSIDE YOUR CAR.

Seating and trims-suds only should be applied to seats and trim with a damp cloth, sponge, or soft brush and rubbed gently. The 'suds should then be removed with a clean, damp cloth or sponge Finally, the surface should be wiped dry with a soft cloth.

CARE OF YOUR CABRIOLET TOP

The top is made of water-proof material, and to remove oil spots use a mild soap solution or gasoline and through rinsing with cold water. Do not use thinners for cleaning, since such use removes the water resistance of the material.